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DISCIFORM DEGENERATION OF THE MACULA

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Disciform degeneration of the macula (Junius-Kuhnt) is a rather common but frequently unrecognized type of senile ocular disease. It is usually bilateral and is characterized by the presence of an elevated mass in the macular region with deep hemorrhages, pigmentary changes and frequently white, punctate areas of degeneration in the surrounding fundus.

The disease is not rare, as is attested by the fact that twelve cases were seen in the ophthalmologic clinic of the State University of Iowa during the past year.

Sclerosis of the choroidal vessels, occurring with generalized vascular disease, is believed to cause metaplasia and hyperplasia of the pigment epithelium with the formation of a mass resembling connective tissue between the choroid and the retina.

Loss of central vision invariably accompanies the disease; it usually comes on rather rapidly and progresses over a period of weeks or months until only large objects are visible. A central scotoma may be noted by the patient. Metamorphopsia and, less frequently, photopsia may be present in the early stages. The vision is poor, and the field shows a central scotoma.

The macular area has been reported to appear normal in the early stages; other reports describe deep hemorrhages, a diffuse veil-like opacity, a subretinal cystic lesion and discrete, white, punctate areas. The disease is recognized only rarely in such early stages; usually one must depend on the presence of an elevated lesion to establish the diagnosis.

Disciform degeneration appears in the macular region as a yellowish-white or gray opaque mass situated beneath the transparent retina. The lesion may be only slightly elevated or it may reach an elevation of 5 or 6 diopters, as measured with the ophthalmoscope. The size varies from an area smaller than the nerve head to one many times larger. Many of the lesions are disciform, but they may assume almost any form. The margins may be distinct and sharply elevated or soft with a gradual elevation; marginal hemorrhages and deposits of pigment

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are frequently noted. The surface is often uneven, with localized depressions here and there; hemorrhages and clumps of pigment may be present. In rare instances the lesion appears to be translucent. The overlying retina is transparent and is usually applied closely to the surface of the mass, but in some cases there appears to be a transparent fluid between the retina and the proliferated tissue. Small cystic areas may be present in the retina over the lesion.

Deep hemorrhages, apparently located under the retina, are commonly found in the area bordering the mass. White, punctate areas of retinal degeneration, sometimes of a type simulating retinitis circinata, may be associated with the elevated macular lesion. The retinal vessels often show evidences of angiosclerosis, and occasionally the choroidal vessels are sclerosed. The peripheral portion of the fundus is usually normal.

Rapid changes may take place in the lesion, and bordering hemorrhages and degenerative changes may come and go with great rapidity.

The prognosis for vision is poor, but in rare instances there may be improvement.

Choroidal scarcoma, Coats' disease and conglomerate tubercle must be considered in the differential diagnosis. Sarcoma of the choroid is usually unilateral and is not limited to the macular region; there are no deep hemorrhages; degenerative lesions in the retina are absent, and often the retina is detached. Coats' disease and conglomerate tubercle usually occur in young persons, are unilateral, develop rapidly and cause rapid degeneration of the eyeball.

REPORT OF CASES

CASE 1.—S. I., a man aged 82 years, entered the ophthalmologic clinic on June 26, 1934, because of failing vision. General examination revealed aortic and generalized arteriosclerosis, a blood pressure of 186 mm. of mercury systolic and 80 diastolic and pulmonary emphysema.

Right Eye.—The patient had accidentally discovered two years before that the eye was almost blind. Examination at the time of admission showed that he could count fingers at 0.16 meter. There was evidence of advanced arcus senilis with senile marginal degeneration, atrophy of the iris and early nuclear sclerosis of the lens, and there were stringy opacities in the vitreous.

Examination of the fundus (fig. 1) showed that the nerve head was normal. The retinal arteries were contracted and the light reflex was exaggerated. In the macula was a large lesion bordered by an irregularly oval, mottled, nodular, grayish-white, elevated rim of pathologic tissue, apparently situated beneath the transparent retina. The peripheral margin of the rim was irregular, and tongue-like extensions reached out and were gradually lost in the normal fundus; some pigmentation was present along the nasal margin. The inner edge of the rim was smooth and sloped off rapidly to a large central depression, which was grayish orange and somewhat elevated above the general level of the fundus. In this depression was an inverted, T-shaped, vascular channel, evidently an extension

from the choroid; its nasal arm appeared to communicate with a small branch from the superior temporal vein of the retina. Small, irregular accumulations of pigment lay along the walls of this vascular channel. Several areas of depigmentation were seen along the course of the inferior temporal vessels of the retina. The peripheral portion of the fundus was normal.

Left Eye.—There had been visual failure accompanied with metamorphopsia for two months. Fingers were counted at 0.16 meter. The external appearance of the eye and the condition of the media were the same as noted in the right eye.

Examination of the fundus (fig. 2) revealed that the nerve head and retinal vessels were normal. In the macular region was a large, irregular subretinal hemorrhage with ragged margins and a mottled appearance; it apparently had been formed by repeated, isolated extravasations which had become confluent. The

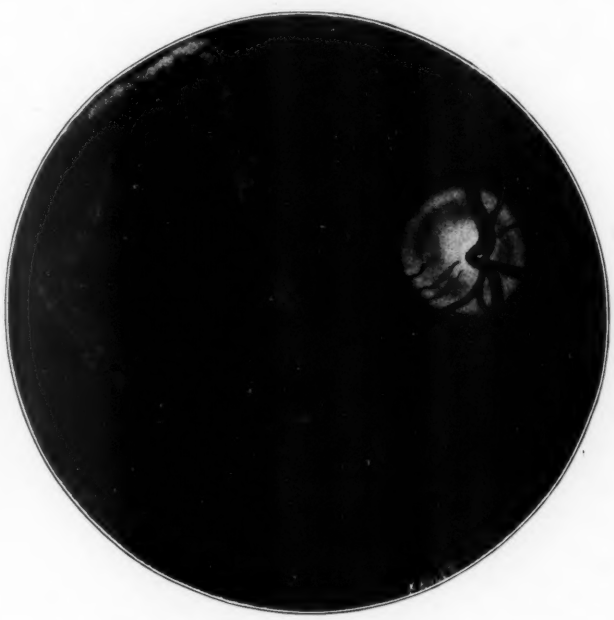

Fig. 1 (case 1).—Drawing of the fundus of the right eye showing degeneration of the macula.

central area was less dense, and the orange fundus reflex was perceptible, but the margins showed many thick, dark red extravasations. The hemorrhage was mottled in the upper temporal portion. Three small extravasations lay in the vicinity of the superior temporal vein. The peripheral portion of the fundus was normal.

CASE 2.—C. S., a man aged 72, was admitted on Feb. 1, 1934, on account of failing vision, carcinoma of the lip, mild diabetes mellitus and arteriosclerosis. Laboratory examination showed that the blood sugar value was 204 mg. per hundred cubic centimeters. The blood pressure was 110 systolic and 50 diastolic. The Wassermann reaction was negative. Microscopic examination of tissue from the deltoid muscle showed evidence of moderate arteriolar sclerosis.

Right Eye.—Two years before, vision had failed fairly rapidly over a period of two months, but since then the condition had remained stationary. Corrected

vision was 5/60. There was evidence of moderate arcus senilis, atrophy of the iris and early incipient cataract.

Examination of the fundus showed that the nerve head and retinal vessels were normal. In the macular area was a large, disciform, gray, sharply marginated, elevated lesion with a pigmented, triangular extension from the superior temporal margin. The retinal vessels arched over the steep margins of the pathologic area and crossed without apparent change. The surface of the lesion was smooth except centrally, where there was an irregular depression approximately the size of the nerve head in which the orange fundus reflex was visible. A small hemorrhage was present in the nasal portion of the pathologic area, and along the inferior and temporal margins was a fine line of pigment. The triangular extension, stretching upward and temporally, was less prominent and not so sharply marginated and showed irregular pigmentation; it flattened out gradually at the blunt apex into a depigmented area in which the choroidal vessels were visible. Between the macular lesion and the nerve head was a small area of disturbance in the pigment epithelium. Two small, sharply marginated, white areas of retinal degeneration were seen along the course of the inferior temporal vessels; the area near the nerve head contained many cholesterol crystals.

Fig. 2 (case 1).—The fundus of the left eye.

On April 2, 1934, the vision had fallen to 0.5/60, but there was little change in the appearance of the fundus (fig. 3). Two oblique, elongated depressions had appeared near the center of the prominent gray mass, and through these areas of thinning the orange reflex of the fundus was visible. The pigmented line along the inferior and temporal margins of the lesion and the small hemorrhage on the nasal side had disappeared. A small pigmented area had formed over the lower margin of the lesion.

On June 16, 1934, the only change appeared to be some lateral and downward enlargement of the lower central depression.

On Aug. 15, 1934, the vision was 1/60 and the lesion in the fundus appeared to be unchanged.

Left Eye.—Vision had failed gradually for two months. Corrected vision was 6/60. There was evidence of moderate arcus senilis, atrophy of the iris and early incipient cataract.

Examination of the fundus showed that the nerve head and the retinal vessels were normal. At the macula was a cloudy, gray, irregular, dumb-bell-shaped, elevated lesion. No hemorrhages or changes in the pigmentation were present.

On April 2, 1934, corrected vision was 6/60 and the field showed a central scotoma extending to the blindspot and breaking through to the nasal periphery.

Fig. 3 (case 2).—The fundus of the right eye, April 2, 1934.

A crescentic area of circumpapillary atrophy was present at the temporal side of the nerve head (fig. 4). The retinal vessels appeared to be normal. In the macular region and extending upward and nasally from it was a softly marginated, gray, irregular, dumb-bell-shaped, elevated lesion which showed some pigmentation and hemorrhagic areas on the surface. The retinal vessels arched forward over the elevation. Along the inferior nasal margin of the temporal expansion was a black crescent of pigment which overhung and partially enclosed a small depression; other accumulations of pigment were also present in this area. The upward and nasal expansion was mottled gray and was bordered nasally by a large hemorrhage. The margins of the hemorrhagic area were sharp and dark red except in the upper portion, where the hemorrhage was thinner and of a lighter shade. A small, crescentic white area lay in the central portion of the hemorrhage. There were two small hemorrhages lateral to the upper margin of the large extravasation.

The macular lesion was surrounded by a large area of degeneration in the pigment epithelium and by sclerosis of the choroidal vessels. The remainder of the fundus appeared to be normal.

On June 16, 1934, the vision had improved to 6/12—2, the central scotoma had disappeared and the patient was able to read again, but there was constriction of the nasal field. There appeared to be little change in the macular lesion (fig. 5); it was of approximately the same size and shape but sharper in outline, and the margins were steeper. The lower temporal expansion of the lesion had assumed a conical form with the apex toward the vitreous, and a large, dense, irregular triangle of pigment with threadlike extensions had accumulated over the nasal side of the cone. Occupying the site of the former hemorrhage in the globular, upper nasal expansion was a homogeneous, irregular, elongated, gray, scarlike area

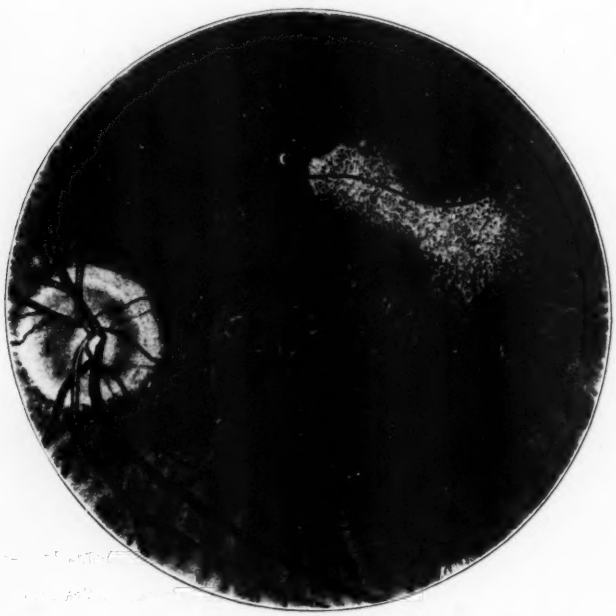

Fig. 4 (case 2).—The fundus of the left eye, April 2, 1934.

surrounded by a narrow zone of blood. The smaller hemorrhages had completely disappeared. The macular lesion was stippled throughout with fine granules and lines of pigment. In the area between the macula and the nerve head the degenerative changes in the pigment epithelium had advanced, the sclerosed choroidal vessels were more prominent and accumulations of pigment were present.

On Aug. 15, 1934, the vision was 6/15. The macular lesion was unchanged except in the upper nasal area where the narrow zone of hemorrhage, which had formerly surrounded the elongated white scar, had disappeared.

Case 3.—Mrs. M. P., aged 70, entered the hospital on April 19, 1934, on account of visual disturbances which had begun with color blindness and blurring of images and which had progressed with gradual failure of vision for ten months. General examination revealed only mild arteriosclerosis; the blood pressure was 138 systolic and 80 diastolic.

Right Eye.—There had been a gradual failure of vision for ten months. Corrected vision was 6/15 + 2. The visual field showed a large centrocecal scotoma. There was evidence of early incipient cataract.

Examination of the fundus (fig. 6) showed that the nerve head was normal but was surrounded by a zone of circumpapillary atrophy. The retinal vessels appeared to be normal, although the fine macular branches were unusually prominent. A gray, disciform, elevated lesion with gently sloping, pigmented borders was present in the macular area. The lesion appeared to be situated directly beneath the apparently normal, transparent retina. In the center of the mass were two crescentic depressions through which the normal orange fundus reflex was visible. The fundus immediately surrounding the lesion showed fine granular pigmentation. Punctate, white areas of retinal degeneration were present

Fig. 5 (case 2).—The fundus of the left eye, June 16, 1934.

in the area temporal to the macula and also below, along the inferior temporal vessels. A small, punctate retinal hemorrhage was seen nasal to the lesion and another below. Above and temporal to the macula was a large choroidal nevus. Otherwise the peripheral fundus was normal.

On Oct. 12, 1934, the corrected vision was 6/21, the central scotoma had broken through to the upper periphery, the lens was more opaque and the macular lesion had increased in size (fig. 7). The mass was somewhat rectangular with soft, undulating, gently sloping margins. The irregular, elongated, white central area of the mass was well elevated above the level of the fundus, and extending horizontally through the center were a number of vessels evidently from the choroidal system. These vessels did not communicate with those of the retina. The surface of the lesion was uneven and showed a number of depressions, the largest of which was situated in the inferior nasal area. Retinal vessels coursing across the mass appeared to be separated from the opaque, white area by the normal,

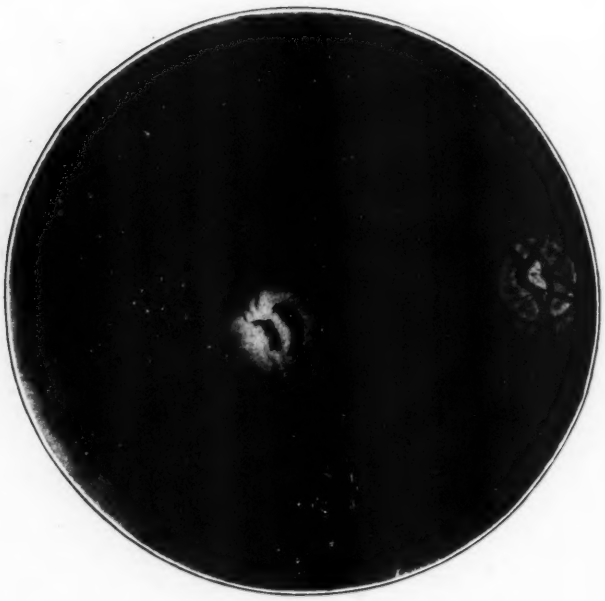

Fig. 6 (case 3).—The fundus of the right eye, April 19, 1934.

Fig. 7 (case 3).—The fundus of the right eye, Oct. 12, 1934.

transparent retina. A few linear and punctate, white areas of retinal degeneration were seen along the inferior temporal vein. The choroidal nevus and peripheral portion of the fundus remained unchanged.

Left Eye.—Visual failure had been developing for ten months. Corrected vision was 6/15. The visual field showed a small, relatively central scotoma. There was evidence of early incipient cataract.

Examination of the fundus (fig. 8) showed that the nerve head and retinal vessels were normal. The macular area was occupied by a gray, softly marginated, disciform, slightly elevated lesion, approximately the size of the nerve head. Small granules of pigment were visible at the center and around the edges of the mass. A few fine, punctate, white areas of retinal degeneration lay between the nerve head and the macula and an occasional similar area along the course

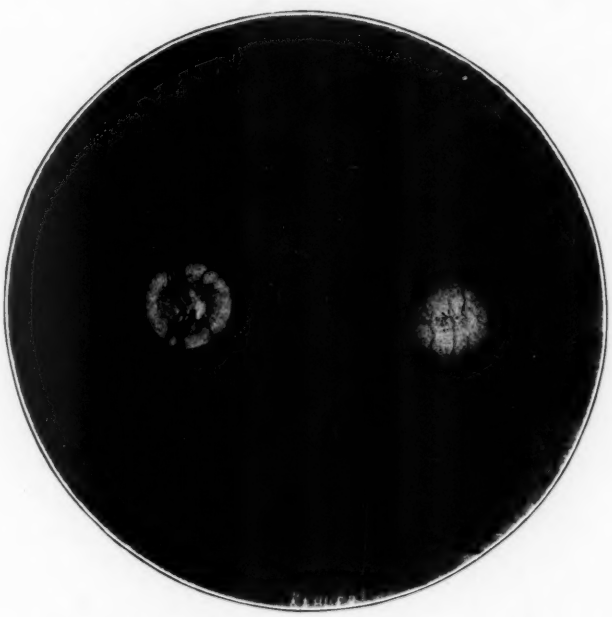

Fig. 8 (case 3).—The fundus of the left eye, April 19, 1934.

of the superior temporal vein. No hemorrhages were found. The periphery of the fundus was normal.

On Oct. 12, 1934, corrected vision was 6/21, and the central scotoma had almost doubled in size, but there was no apparent change in the macular lesion. A few more punctate, white areas of retinal degeneration had formed between the macula and the superior temporal vessels.

CASE 4.—J. H., a robust man aged 70, entered the clinic on June 20, 1934, because of failing vision. General physical examination revealed nothing abnormal. The blood pressure was 118 systolic and 86 diastolic. A portion of the deltoid muscle, which was removed for biopsy, showed arteriolar sclerosis.

Right Eye.—Failure of vision had begun three years before with blurring, metamorphopsia, photopsia and a central scotoma, which was especially noticeable under poor illumination. Finally objects were seen only by eccentric fixation.

Vision was eccentric: 0.5/60. There was evidence of moderate arcus senilis, and many stringy opacities were noted in the vitreous.

Examination of the fundus (fig. 9) showed that the nerve head and retinal vessels were normal. A large, irregularly rectangular, elevated, sharply marginated gray mass was present in the macular area. Its surface was uneven; in places the elevation reached approximately 2 diopters, while in other areas it reached barely above the general level of the fundus. In the upper nasal fifth of the fundus, above the superior temporal vein, the mass was most prominent; it was light gray, its surface was smooth and there was an irregular, interrupted line of pigment near the superior and temporal margins. Two narrow, gray, elevated bands of tissue, one at the temporal margin and the other near the center of the mass, extended downward to the prominent inferior temporal portion of

Fig. 9 (case 4).—The fundus of the right eye.

the lesion. The latter area was also greatly elevated and light gray and showed a comparatively smooth surface. Along the inferior and temporal margins clumps of pigment had collected, and there were two tonguelike, gray, downward extensions from this lower area. At the temporal margin was a linear depression in the retina and, just lateral to this, an irregular, indefinite, gray, slightly elevated area. The central three fifths of the lesion was less elevated and its contour was irregular. The smaller, temporal portion, aside from the nasal and temporal bordering bands, was only slightly elevated and appeared as a veal-like obscuration of the normal fundus reflex; irregular clumps of pigment were present in the upper portions. The larger nasal portion of the central area was lighter in color and more elevated, and its surface was irregular; in some areas the pathologic tissue appeared to be thick, and in others it was veil-like and thin, allowing perception of the orange fundus reflex. Near the center were white radial striae and three rather large, deep, semicircular, choroidal vessels. Along the nasal

margin aggregations of pigment were present. No hemorrhages were seen. Temporal to the macular lesion were many white punctate areas of retinal degeneration, and the choroidal vessels appeared to be sclerosed.

Left Eye.—Reading had been difficult for one year, and recently there had been blurring of distant objects and a central dark area in the visual field. Corrected vision was 6/60. There was evidence of moderate arcus senilis, and many stringy opacities were noted in the vitreous.

Examination of the fundus (fig. 10) showed that the nerve head was normal but surrounded by a ring of circumpapillary atrophy. The retinal vessels showed no changes aside from a slight lessening in caliber. The macula presented a gray, semicircular, heavily pigmented, moderately elevated lesion. The margins were soft and sloped gently into the surrounding fundus. Within the semicircular area

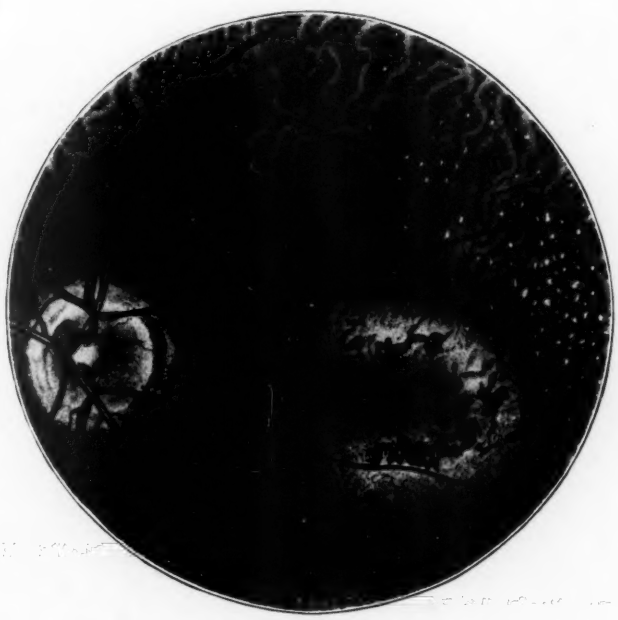

Fig. 10 (case 4).—The fundus of the left eye.

the retina appeared to be depressed below the general level of the fundus. There were no hemorrhages. Small punctate areas of retinal degeneration, some apparently containing cholesterol, were present, especially in the area above and temporal to the lesion. Moderate sclerosis of the choroidal vessels was also apparent.

CASE 5.—C. B., a man aged 80, was seen on June 8, 1934, on account of failing vision in the right eye. The left eye had been enucleated following an injury in 1926. Aside from a blood pressure of 190 systolic and 90 diastolic the general physical examination revealed no abnormalities. Microscopic studies of biopsy material from the deltoid muscle showed arteriolar sclerosis.

Right Eye.—There had been gradual failure of vision for one year. Vision was eccentric; movements of the hand were noted at a distance of 0.3 meter. Evidences of arcus senilis, early nuclear sclerosis and a few cortical opacities in the lens and an occasional vitreous opacity were present.

Examination of the fundus (fig. 11) showed that the nerve head was normal. Arteriosclerotic changes were visible in the retinal vessels. At the macula was a large, gray, disciform, elevated lesion which was entirely surrounded by hemorrhage. The elevated area was divided by a broad, irregular, curved band of hemorrhage into a larger, crescentic, lower portion and a smaller, irregularly oval, upper portion. This hemorrhagic band, which was pigmented here and there, fused on either side with the surrounding hemorrhage; it appeared mottled since the layer of blood was thin and light in some areas and thick and dark in others. The upper, oval portion of the elevated area above the hemorrhagic band was slate gray as a result of an admixture of pigment and showed an elevation of approximately 2 diopters, while the lower, larger, crescentic area was light gray and not so prominent. Four small punctate hemorrhages were

Fig. 11 (case 5).—The fundus of the right eye, June 8, 1934.

seen near the temporal margin of the upper oval area. The hemorrhagic extravasation around the mass was broad above but gradually narrowed at either side, and along the inferior border of the lower crescentic area it dwindled to a thin marginal line. It appeared to have been formed by the confluence of many isolated extravasations, and areas of increased density were visible in the upper portion. In the retina overlying the hemorrhage were several small, yellowish-white areas of degeneration. The peripheral portion of the fundus was normal.

On Aug. 14, 1934 (fig. 12), the eye was examined again, and many changes had occurred in the macular lesion. The large, crescentic, lower portion below the pigmented, hemorrhagic band had shrunk into a smaller, gray, triangular area; it was less elevated, and on the surface were two large and several small punctate hemorrhages. Pigment had accumulated at the nasal angle and along the inferior border. The area above the band of pigment and hemorrhage had enlarged somewhat and was less prominent, and its appearance had completely changed; it was

translucent and a dirty grayish orange. The hemorrhage surrounding the lesion had decreased in size and had entirely disappeared below; it was mottled and seemed to have been formed by many small coalescing extravasations. Pigment had accumulated here and there in the hemorrhagic area. A larger number of yellowish-white areas of retinal degeneration were present.

CASE 6.—Mrs. N. B., aged 48 years, was seen on Feb. 27, 1934, on account of failure of vision in the left eye. Aside from obesity and a blood pressure of 162 systolic and 106 diastolic, physical examination revealed no abnormalities.

Right Eye.—Corrected vision was 6/6, the field showed no abnormalities and the media and fundus were normal.

Left Eye.—In July 1932 there was blurring of print and metamorphopsia had appeared; later a positive central scotoma was noted, and the vision gradually

Fig. 12 (case 5).—The fundus of the right eye, Aug. 14, 1934.

deteriorated. Vision was eccentric; fingers were seen at 0.3 meter. The field showed a large central scotoma. The media were normal.

Examination of the fundus (fig. 13) showed that the nerve head was normal except for a narrow conus at the temporal side; the retinal vessels appeared to be healthy. In the macular region was an irregular, bulbous, opaque, yellowish-white, elevated lesion. The lower margins were sharp and steep, and the maximum elevation in this area was approximately 2 diopters; the upper margins were soft and indefinite and gradually sloped off to the level of the fundus. The tissue was opaque below, but it was thin above, and the normal orange reflex of the fundus was seen as if through a veil. Several small white areas of degeneration and three punctate hemorrhages were present in the retina along the nasal margin of the macular lesion, while below and temporally were two rather large

retinal hemorrhages. The remainder of the fundus was normal except for a small area of old chorioretinitis in the inferior nasal periphery.

Examination of the fundus on April 3, 1934 (fig. 14), revealed that the macular lesion had decreased in size but not in elevation. An elongated oval depression had appeared in the upper portion of the mass, and in this area the orange fundus reflex was visible. The hemorrhages had disappeared, but there was an increase in the number of punctate areas of retinal degeneration along the nasal border, and similar areas had formed above.

On May 3, 1934 (fig. 15), it was found that the pathologic area in the macula was smaller, but there was no change in elevation. The depression in the upper part of the lesion was smaller and somewhat more opaque. The white punctate areas of retinal degeneration had disappeared from the nasal side of the macular

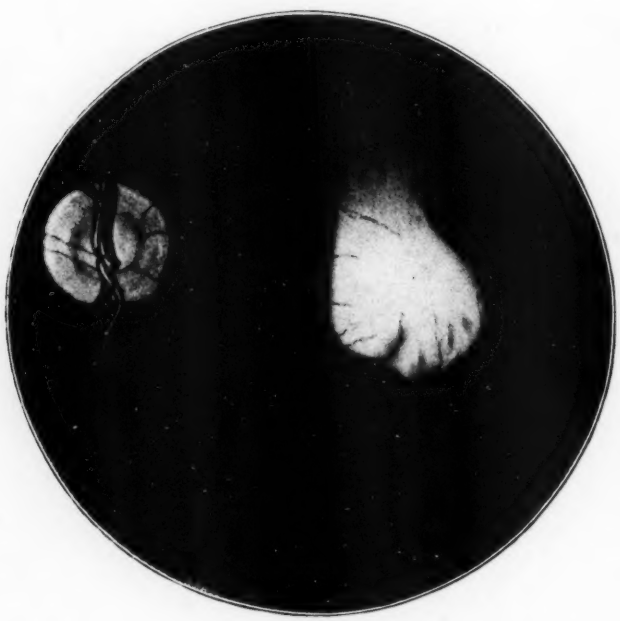

Fig. 13 (case 6).—The fundus of the left eye, Feb. 27, 1934.

lesion, as had many of those at the upper temporal angle, but in the region lateral to the lower portion of the lesion new ones had formed. No hemorrhages were visible.

On Nov. 23, 1934, the lesion appeared to be somewhat more translucent, but otherwise no changes were apparent.

CASE 7.—Mrs. R. I., aged 62, was seen on May 6, 1934, because of failing vision. General physical examination revealed no abnormal condition except a blood pressure of 192 systolic and 84 diastolic.

Right Eye.—There had been gradual failure of vision since December 1931. Corrected vision was 6/60. A central scotoma was found in the field of vision. The media were normal.

Examination of the fundus showed that there was a white elevated lesion surrounded by hemorrhages in the macular region, and in the outlying fundus there were a few small white areas of retinal degeneration.

Fig. 14 (case 6).—The fundus of the left eye, April 3, 1934.

Fig. 15 (case 6).—The fundus of the left eye, May 3, 1934.

On May 21, 1934 (fig. 16), vision was 3/60, the anterior segment was normal and the media were clear. The nerve head was normal, and, aside from moderate constriction of the arteries and an increase in the number of visible vessels in the macular area, the retinal vessels were normal. A delicate gray, translucent, elevated mass, which appeared mottled as a result of disturbances in the underlying pigment epithelium, occupied the macular region. Surrounding the macular lesion was a zone of sharply marginated, isolated and confluent, grayish-white areas of retinal degeneration which had the appearance of circinate retinitis. A few blotchy hemorrhages were present above the macula along the course of the superior temporal vein. The periphery of the fundus was normal.

Left Eye.—There had been visual failure since 1927. Fingers were counted at 0.66 meter. The visual field showed a large central scotoma. The media were normal.

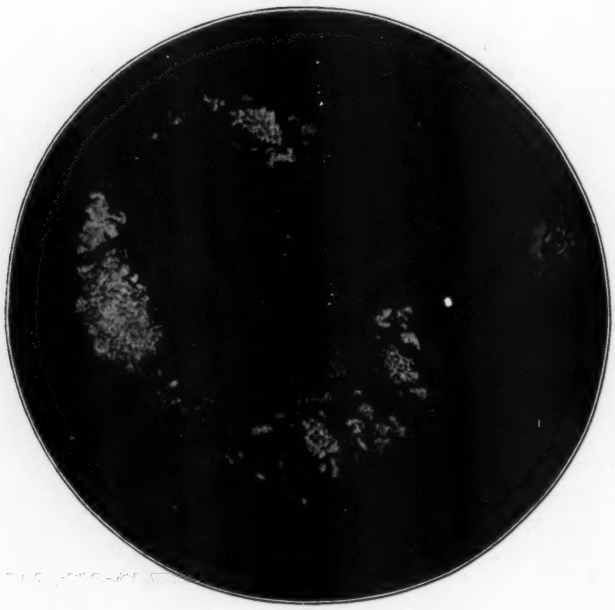

Fig. 16 (case 7).—The fundus of the right eye.

Examination of the fundus showed that there was a scarlike, elevated area in the macular region, and several small white areas of retinal degeneration were found in the surrounding retina.

On May 21, 1934, the patient counted fingers at 0.3 meter. Externally the eye appeared to be normal. A few opaque areas were present in the equatorial regions of the lens, but otherwise the media were clear (fig. 17). The optic nerve head was normal. The retinal arteries showed some constrictions and an increase in the light reflex. The macular region presented a striking picture; over the entire area the retina was elevated, and the appearance was that of a large transparent cyst. Enlarged veins in the transparent retina arched forward across the macula. Several irregular, jagged, gray, proliferative areas surrounded by narrow pigmented borders lay in the deeper areas, evidently in the pigment epithelium. In this region were other pigmented areas but no hemorrhages.

Innumerable small, sharply marginated, white, granular retinal lesions, having the appearance of circinate retinitis, surrounded the cystlike macular area. In places these degenerative areas were isolated, but in great part they were confluent. A few similar degenerative areas were present in the transparent anterior wall of the macular lesion. At the temporal side of the circinate lesion was a large, deep, triangular hemorrhage with punctate, white areas of degeneration in the overlying and bordering retina.

CASE 8.—Mrs. A. P., aged 68, entered the hospital on account of diabetes mellitus, muscular twitchings over the body and poor vision. One leg had been amputated because of gangrene, and five months before admission there had been a transitory hemianesthesia with dysphagia, evidently the result of a small cerebral hemorrhage. The blood pressure was 190 systolic and 106 diastolic, the Wasser-

Fig. 17 (case 7).—The fundus of the left eye.

mann reaction of the blood was negative, and the sugar content was 480 mg. per hundred cubic centimeters. The urine contained a large amount of sugar and some albumin.

Right Eye.—Vision had been poor for five years. At the time of admission hand movements were noted at 0.3 meter. Examination revealed nuclear sclerosis and incipient cataractous changes in the lens and stringy vitreous opacities.

Examination of the fundus (fig. 18) showed that the nerve head was normal. The retinal vessels were reduced in caliber and showed evidence of advanced sclerosis. Some of the smaller arteries were accompanied by white strands, while others were completely obliterated and appeared as dense white lines. Variations in caliber were observed in the veins, and some of the small peripheral branches were obliterated.

In the macular region was an oval, slightly elevated lesion showing an irregularly rectangular, heavily pigmented center with a few threadlike extensions of

pigment nasally and below. Surrounding the central pigmented area was a light depigmented zone which was narrow except temporally, where a small depression was present. Many, chalky-white, discrete and confluent, sharply marginated, granular areas of retinal degeneration were found in the temporal periphery of the fundus and a few in other peripheral regions. These lesions had a tendency

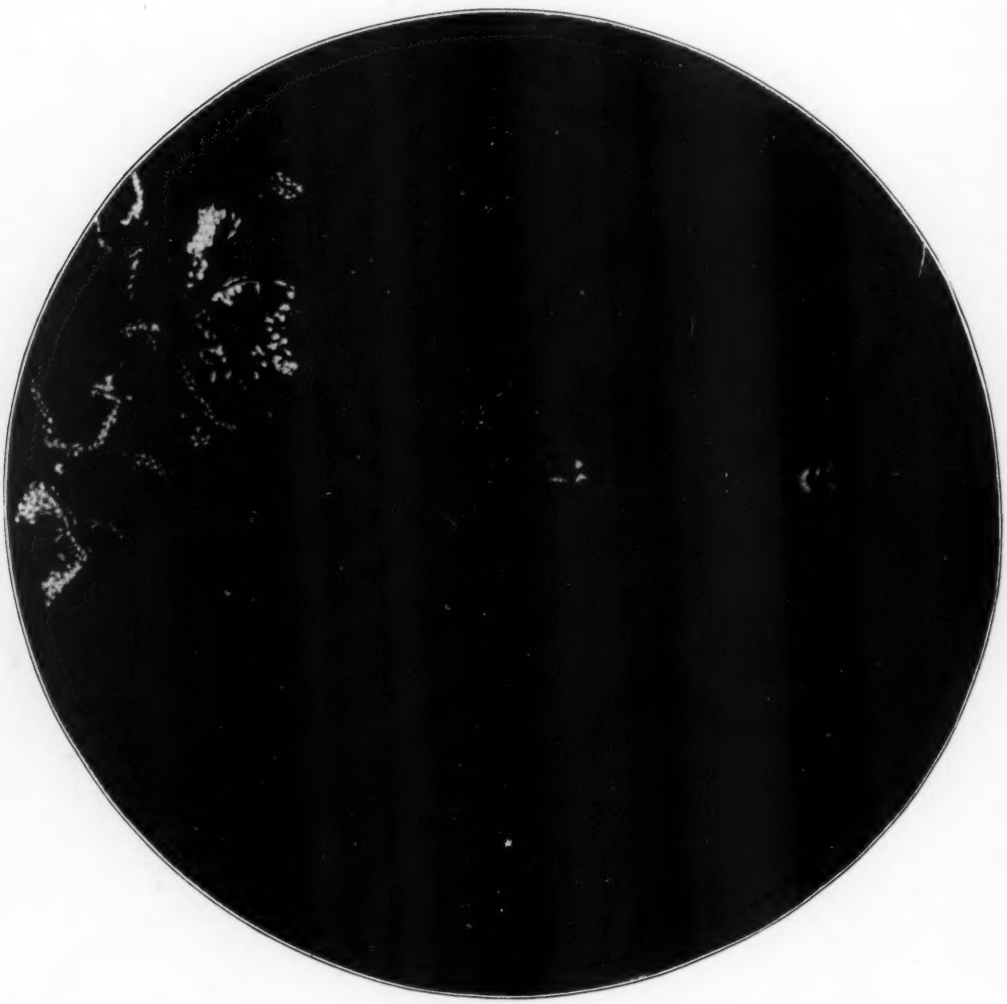

Fig. 18 (case 8).—The fundus of the right eye.

to follow the retinal vessels in some areas and were situated deep in the retina. Hemorrhages were not present in the macular region, but a large, irregular extravasation and a few smaller ones were found along the inferior temporal vein in the periphery. A few small punctate hemorrhages were scattered about between the areas of retinal degeneration in the temporal periphery.

Left Eye.—The vision had been poor for five years. Hand movements were noted at 0.16 meter. Examination revealed nuclear sclerosis and incipient cataractous changes in the lens and stringy vitreous opacities.

Examination of the fundus (fig. 19) showed that the nerve head was normal. There was evidence of advanced vascular sclerosis; the arteries were narrow, and some of the smaller branches appeared as white lines. In the temporal periphery the veins were accompanied by white lines. The macular region presented a roughly rectangular, gray, elevated lesion. Its nasal, superior and temporal margins were sharp and showed steep elevations, while the inferior margin was irregular and less elevated and fused almost imperceptibly with the surrounding retina. Situated within the lesion, slightly to the nasal side, was an inverted, U-shaped depression in which the orange fundus reflex was perceptible. Many small vessels crossed the elevated area of degeneration, and the irregularity of the surface contour was easily determined by the ascent and descent of these vessels. In the inferior temporal area were several small irregularities of the

Fig. 19 (case 8).—The fundus of the left eye.

surface contour. At the superior nasal angle were clumps of pigment and a small knoblike prominence; similar accumulations of pigment were seen along the upper border and in the depressions near the inferior margin. Over the temporal border and above and temporal to the macular lesion were many small, punctate, white areas of degeneration deep in the retina. White areas of retinal degeneration, similar to those in the right eye, were found in the periphery of the fundus.

CASE 9.—Mrs. J. F., aged 72 years, was admitted on April 6, 1934, on account of visual failure in both eyes and pain in the right eye. General physical examination was refused.

Right Eye.—There had been gradual visual failure with attacks of congestion and pain for several years and practically no vision for three months. There was only perception of light.

Examination showed that the conjunctival and circumcorneal vessels were engorged, the cornea was steamy and with the slit lamp the corneal epithelium

appeared edematous. The anterior chamber was shallow, the iris was congested and discolored and the pupil was dilated and fixed. The globe was stony hard.

The media and fundus were not visible. Following enucleation a thorough microscopic study of the eyeball failed to reveal any evidence of disciform degeneration of the macula.

Left Eye.—There had been gradual visual failure for several years with occasional congestion but no pain. Corrected vision was 6/60. The visual field showed a central scotoma and some contraction of the nasal periphery. The anterior chamber was slightly shallow, but otherwise the globe appeared to be normal. The intra-ocular tension was 35 mm. of mercury (Gradle-Schiötz). There was evidence of incipient cataract and nuclear sclerosis of the lens, and many stringy vitreous opacities were noted.

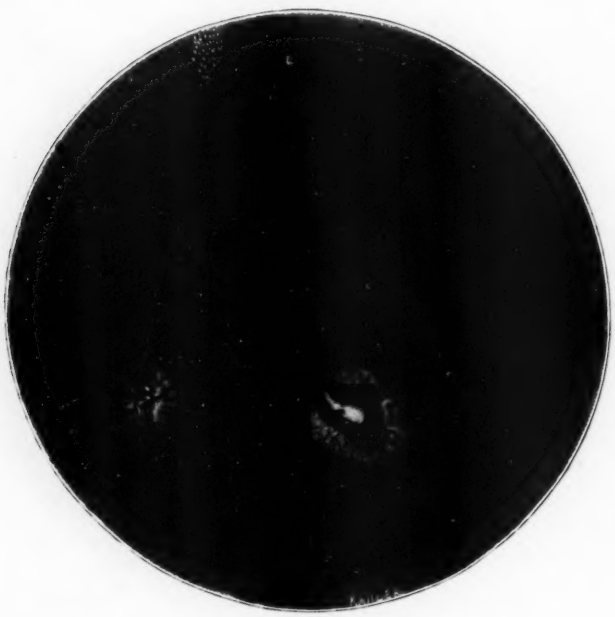

Fig. 20 (case 9).—The fundus of the left eye.

Examination of the fundus (fig. 20) revealed no pathologic cupping of the nerve head but an unusual number of small vessels in this area. The retinal arteries were extremely small and showed other evidences of sclerosis. A triangular elevated lesion with a grayish-white center and densely pigmented borders was present in the macula. Surrounding this area was a broad, sharply marginated, light zone of depigmentation in which choroidal vessels were visible. A few small hemorrhages and two groups of small, white punctate areas of retinal degeneration were seen. The periphery of the fundus appeared to be normal.

Case 10.—Mrs. L. K., aged 43, was seen on Aug. 8, 1932, on account of blurred vision in the right eye for the past two months. At that time the vision was 6/60, the field of vision showed a central scotoma, and there was a gray, disciform, elevated lesion in the macular region which was approximately one-half the size of the nerve head. A small hemorrhage lay along the superior nasal margin of the elevated area. No detailed description was recorded at that time.

Right Eye.—On April 24, 1934 (fig. 21), the vision was 1/60. Externally the globe appeared to be normal and the lens was transparent, but a few, fine, floating opacities were found in the vitreous. The nerve head and retinal vessels were normal. At the macula was a gray, disciform, elevated mass with deeply pigmented margins. Nasally there was a crescentic depigmented area and crossing this horizontally was an elongated linear lesion with pigmented borders. The peripheral portion of the fundus showed no pathologic conditions.

Left Eye.—The left eye was normal.

CASE 11.—Mrs. C. C., aged 52, was referred to the clinic on Nov. 16, 1934, because of poor vision. She was under treatment for generalized arteriosclerosis; at one time the blood pressure had been 240 systolic.

Right Eye.—There had been indistinct vision for nine months. Vision was less than 6/60. Examination showed evidence of early incipient cataract.

Examination of the fundus showed that the nerve head was normal. The retinal vessels showed an advanced stage of arteriosclerosis. The entire macular region

Fig. 21 (case 10).—The fundus of the right eye.

was occupied by a large lesion which appeared as a grayish-white, somewhat translucent, disciform, elevated area, almost entirely surrounded by a broad subretinal hemorrhage. In the overlying retina were several small, limpid cysts. Above the elevated mass the hemorrhagic area was somewhat pigmented. White, punctate areas of retinal degeneration were seen over the hemorrhage and in the region temporal to the macula. The periphery of the fundus was normal.

Left Eye.—Vision had been poor for two years. At examination it was found to be less than 6/60. In this eye also there was evidence of early incipient cataract.

Examination of the fundus showed that the nerve head was normal. There was advanced arteriosclerosis of the retinal vessels. In the macular region was a white, curved, cylindric, elevated lesion with pigmented margins. The peripheral portion of the fundus was normal.

CASE 12.—Mrs. F. P. was referred to the clinic on Oct. 19, 1934, on account of a gradual loss of vision in the right eye during the past three months. There was a history of high blood pressure, but a general physical examination was not made.

Right Eye.—The vision was 6/60; externally the eye appeared to be normal, and the media were clear. The nerve head and retinal vessels were normal. In the macular region was a large, yellowish-gray, elevated lesion measuring 1.5 diopters horizontally and 2 diopters vertically. Its margins were soft but rather steep. The surface of the lesion was smooth except at the inferior temporal angle, where there were several small depressions. A large, pale, subretinal hemorrhage extended from the nasal side of the lesion almost to the nerve head; several small hemorrhages were seen in the lower temporal portion of the elevated area.

Left Eye.—The left eye was normal.

CASE 13.—J. L., a man aged 67 years, was seen on Jan. 10, 1934, because of polyopia and failing vision. The blood pressure was 160 systolic and 100 diastolic.

Right Eye.—Vision had been failing for eighteen months. He could count fingers at 1 meter. Examination revealed evidence of early incipient cataract.

Examination of the fundus revealed that the nerve head was somewhat atrophic and that there were advanced arteriosclerotic changes in the retinal vessels. A white, elevated lesion covered the entire macular area and extended almost to the nerve head. A few hemorrhages were scattered about in the papillomacular region. The peripheral fundus was normal.

Left Eye.—Vision had been failing for six months. Fingers were counted at 1 meter. There was evidence of early incipient cataract.

Examination of the fundus revealed a lesion in the macular region similar to that in the right eye but somewhat less extensive.

CASE 14.—Mrs. A. R., aged 56, was referred to the clinic on June 23, 1930, because of poor vision in the left eye. She had mild diabetes and arteriosclerosis. The blood pressure was 190 systolic and 100 diastolic.

Right Eye.—No abnormalities were found.

Left Eye.—Vision had been failing for one year. At the time of examination it was 2/60. The media appeared to be normal.

Examination of the fundus showed that the nerve head was normal. Moderate arterioscleroic changes were present in the retinal vessels. A gray, somewhat pigmented, elevated lesion occupied the region of the macula. The peripheral fundus was normal.

CASE 15.—Mrs. H. B., aged 73, was seen on July 15, 1933, because of failing vision. She stated that there had been hemorrhages in the eyes for a number of years. There was no history of organic disease, and the blood pressure was 130 systolic and 70 diastolic. The vision was less than 6/60 in each eye. Each macular region was the seat of a gray, elevated lesion in and around which were many hemorrhages and small, white, punctate areas of retinal degeneration.

SUMMARY

Disciform degeneration of the macula is an uncommon disease but evidently not one of great rarity. In the fifteen cases herein reported it occurred, as is usual, in both eyes and in persons with generalized arteriosclerosis. The lesion usually appeared as a gray, elevated mass under the retina; subretinal hemorrhages and pigmentary disturbances in the surrounding area were common, and in a few cases there were white punctate areas of degeneration deep in the retina. The diagnosis is of importance since the lesion may be confused with that of sarcoma of the choroid.

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JUVENILE MACULAR EXUDATIVE RETINITIS (JUNIUS)

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C. A., a mulatto woman aged 23, first came to my clinic at the Episcopal Eye, Ear and Throat Hospital in October 1932. She complained of aching of the eyes after reading. The visual acuity was 20/20—2 in each eye. In each macular region was found an oval, golden yellow area over which the retinal vessels passed (fig. 1). There were corresponding relative central scotomas (fig. 2). In addition, there was a similar but smaller area in the right eye, about one-sixth the size of the disk, above and adjacent to the superior temporal artery, 2 disk diameters from the disk (fig. 1). Two weeks later the vision was reduced to 20/100 in the right eye and 20/70 in the left. (All visual acuities given here are with correction.) There was no change in the appearance of the lesions described.

The personal and family history were irrelevant.

In January 1933, three and one-half months later, there was no change in the appearance of the fundi, although the vision was 20/20 in the right eye and 20/40 in the left. In May, seven months later, the visual acuity was 20/50 in the right eye and 20/100 in the left. The condition in the right eye appeared unchanged. The lesion in the left eye had contracted, and an indentation on the nasal side gave it a heart-shaped appearance. The lower nasal portion was smaller than the upper nasal part, and the color in the former area had changed to grayish white. This area was somewhat mottled, and it was thought after using the red-free and green-free filters that there were one or two minute hemorrhages. The outline of the whole area was less sharp and clear than it was formerly (fig. 3). The peripheral fields for form and blindspots were normal.

In June 1933, eight months after the patient was first seen, the lesion in the right eye remained unchanged. Perhaps the color had changed to a deeper hue, more nearly lemon yellow, and the reflex sheen was a little more pronounced. In the left eye, the lesion was smaller and there were finger-like indentations in the upper temporal part and some deposition of pigment. The visual acuity was 20/50 +1 in the right eye and 20/70 in the left.

Ten months after the original examination the right eye still appeared about the same, but the vision had improved to 20/20—4; the vision in the left eye was 20/100+1, and apparently no change had occurred in the lesion since the previous examination.

One year after the original examination the visual acuity, with a cycloplegic, was 20/25 in the right eye and 20/40—2 in the left. The fundi showed no marked change in spite of the improvement in vision.

From the Department of Ophthalmology, George Washington University School of Medicine.

Read before the Section of Ophthalmology of the College of Physicians of Philadelphia, April 19, 1934.

In February 1934 the visual acuity was 20/30—2 in the right eye and 20/30+3 in the left.

Ophthalmoscopic examination of the right eye revealed little gross change in the lesion. The edge was fairly sharply outlined, perhaps a little less so than previously noted. The center was lighter, of a canary yellow-green color. Retro-illumination of this central area, which was probably the foveal region, by the narrow slit of the Friedenwald ophthalmoscope showed that it was not homogeneous but was mottled in the temporal half.

In the left eye the skeleton of the yellow oval could be seen, and within it was another heart-shaped outline. The apex of the indentation of this appeared to be the fovea, which apparently had been spared. Above and below the fovea nasally were some whitish scars. No other pathologic changes were noted.

The patient was last seen in October 1934, when the visual acuity was 20/100 in the right eye and was unimproved by glasses; it was 20/30—3 in the left eye and with a —0.50 sphere was 20/20—4. The lesion in the right eye had lost

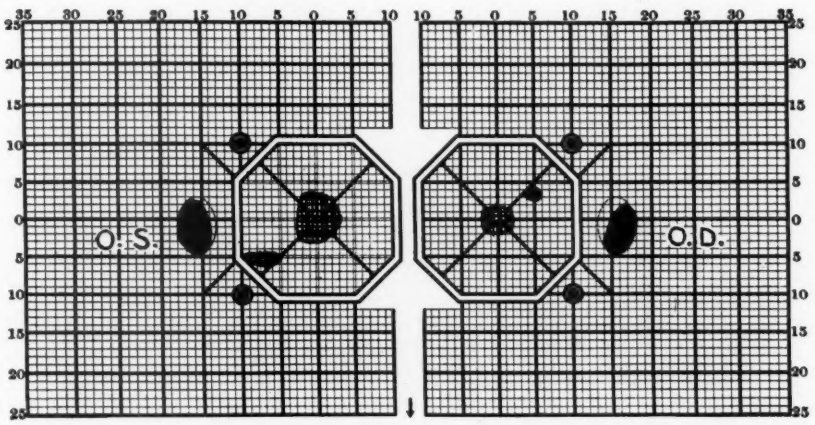

Fig. 2 (case 1).—Lloyd stereocampimeter charts of the right and left eyes, showing relative scotomas.

much of its bright yellow color and was decidedly grayish. The edges were swollen, and the details were much less sharp and distinct. There were indentations below, suggesting that the lesion was shrinking. Surrounding the lesion the retinal reflexes were much more pronounced (fig. 4).

The left eye had lost the yellow color entirely. Only the skeleton of the original lesion was seen, in which was the smaller heart-shaped area. The whole lesion was mottled. The surrounding retina was apparently normal as seen with both direct and transmitted illumination (fig. 5).

Summary.—A case of exudative macular retinitis in an otherwise healthy young mulatto woman is presented. The case is unusual in that the retinitis was bilaterally symmetrical and showed no change in one eye for nearly eighteen months. The etiology is not known.

The medical survey was as follows: The patient was well developed and well nourished. The head was normal. The hearing was good. Otoscopic examination gave negative results. There was no nasal or postnasal discharge. Roentgenograms of the teeth were normal. The tongue was clean. The tonsils were small and embedded, but otherwise the throat was normal. The right submaxillary

lymph glands were slightly enlarged and apparently slightly tender. There was no other glandular enlargement. The thyroid gland was palpable and slightly enlarged.

There was no enlargement of the heart. The point of maximum intensity was diffuse. The sounds were good. There was a short systolic murmur at the pulmonic area, the pulmonic second sound being greater than the aortic second sound. The rate and rhythm were normal. The blood pressure was 118 systolic and 65 diastolic.

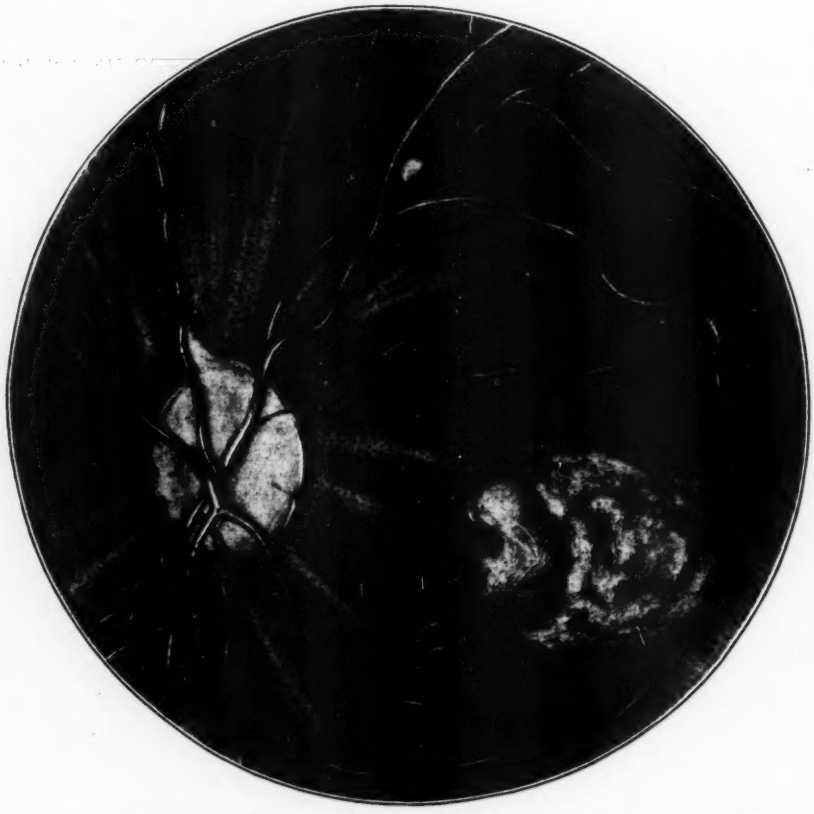

Fig. 3 (case 1).—The appearance of the left fundus in April 1934. The lesion had lost its golden yellow color and was contracting, especially nasally, where there was a definite indentation. There was no elevation in either eye.

The lungs were clear clinically; roentgenologically there was mild bronchial infection. The abdomen was scaphoid and soft. The liver and spleen were not palpable. In the left lower quadrant there was a hard cylindric smooth mass which felt like feces in the colon. There was slight tenderness over this mass.

The urethra, vulva and vagina were normal. There were slight inflammation and slight discharge from the cervix; a cervical smear showed a few pus cells and an abundance of bacterial flora but no gram-negative intracellular diplococci. The uterus was acutely antiflexed but was otherwise normal. The adnexae were normal. There was a faint trace of albumin in the urine as well as a moder-

Fig. 1 (case 1).—The appearance of the right fundus in 1932. The lesion in the left eye was almost identical. Visual acuity was 20/20—2 in each eye.

Fig. 6 (case 2).—Appearance of the right eye in April 1934, with a purple-gray anastomotic angioid network which passes under the vessels. The lesion is shaped like a ping-pong paddle, sharply circumscribed and elevated 3 diopters. A central depression gives it a doughnut appearance. There were some fine newly formed blood vessels in it, which are not shown.

Fig. 4 (case 1).—Photograph of the right eye in October 1934. The edges were hazy with indentations below. The surrounding white areas are reflexes. The visual acuity was 20/100.

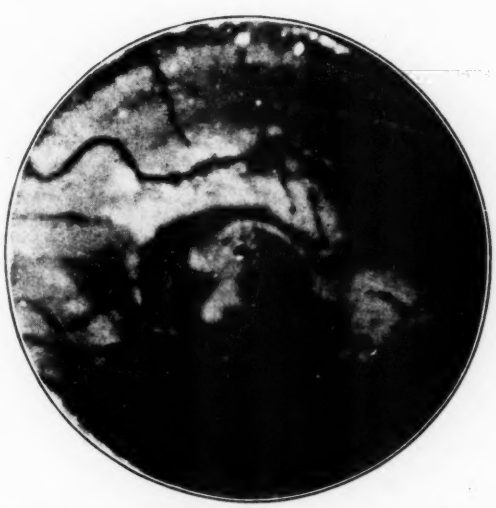

Fig. 5 (case 1).—Photograph of the left eye in October 1934, showing the outline of the original lesion and the mottling within it. The heart-shaped outline within the original lesion is well shown. The visual acuity was 20/20—4.

ate number of pus cells; this condition cleared up entirely with the use of methenamine. A specimen of 332 cc. of urine obtained during the day had a specific gravity of 1.020 and contained no sugar or acetone bodies, abundant bacteria, some white cells and a few epithelial cells. A specimen of 600 cc. obtained at night had a specific gravity of 1.010. The other findings were the same as in the specimen obtained during the day.

The extremities and reflexes were normal.

The white blood cell count was 10,600, with 72 per cent segmented cells, 3 per cent band cells, 1 per cent eosinophils and 24 per cent lymphocytes. The red blood cell count was 3,920,000, with 65 per cent hemoglobin. Provocative Wassermann and Kahn tests were negative.

REVIEW OF THE LITERATURE

A discussion of macular disease in adults, and in persons of advanced age is enlightening in attempting to understand the underlying causes of the juvenile form of retinitis exsudativa macularis. Junius [1] discussed this at length in 1930. The types he discussed have no connection with the types of exudative retinitis named after Coats [2] and von Hippel.[3] They are distinguished from the latter forms by the nature of their termination and also by their curability. They have a different etiology, which is still to be explained.

In the juvenile form of exudative retinitis, as in the senile form, the lesions may be polymorphous. It is presumed, apparently without adequate information, that the senile form is due in large part to vascular degeneration or disease. In the case of the juvenile form an attempt has been made to prove the same etiology, but insufficient pathologic material has been studied to enable a definite theory as to the etiology to be established. Different authors have attempted to explain these rarely observed visual disturbances by injury of the smallest marginal vessels which supply the macula. In the cases reported and quoted by Junius there was often a predisposition to vascular disease or a vasoneurotic constitution. A history of syphilis was frequently obtained. "In addition to syphilis, which is the basic cause, there are other nonsyphilitic circulatory disturbances which contribute to produce the disease."

If one considers vascular disease as a cause, one can imagine that various toxins, including that of syphilis, may be responsible. While this disease might be a predominating cause in Europe, in my experience

1. Junius, Paul: Erscheinungsformen und Ablauf der juvenilen Retinitis exsudativa macularis, Ztschr. f. Augenh. **70**:129, 1930. Junius, Paul, and Kuhnt, Hermann: Die scheibenförmige Entartung der Netzhautmitte, Berlin, S. Karger, 1926, vol. 7.

2. Coats, G.: Forms of Retinal Disease with Massive Exudation, Roy. London Ophth. Hosp. Rep. **18**:440, 1907-1908.

3. von Hippel, E.: Anatomischer Befund bei einem Falle von Retinitis exsudativa (Coats), Arch. f. Ophth. **86**:443, 1913.

it is not so in the United States, certainly not in the cases seen in private practice. Junius considered that the common feature is the vascular basis of the disease. One must confess, however, that this is scarcely proved, since in many cases, the one reported here for example, no evidence of vascular disease can be shown. He further remarked in his monograph that one is completely in the dark regarding the etiology of juvenile macular exudative retinitis. "A complete understanding of the disease will be possible only when much more is known regarding the chemical phenomena concerned in the nutrition of the center of the retina under physiologic and pathologic conditions. It is difficult to obtain anatomic material for research, so only clinical observation is available."

In Danco's [4] report of a case of juvenile exudative retinitis in a boy of 13 years the opinion was expressed that the retinal changes were due to undernourishment of the retina in the manner recently described by Schieck, who supported Volhard's theory that albuminuric retinitis is the result of an ischemia which is due not always to direct organic changes of the wall of the vessel but sometimes to contraction of the vessel; this may later be accompanied by proliferation of vascular endothelium.

Wirtz and Liebermeister [5] stressed the occurrence of a hole at the macula resulting from edema. They considered the case discussed as an instance of Quincke's acute circumscribed edema, which is comparatively rare but may be localized in any organ. Quincke's more recent view is that edema can occur histogenetically and only occasionally may the vascular walls play a part therein. In the case that he reported the following data lend color to this hypothesis: edema without changes in the vessels, which later occurred secondarily; periodic attacks of blindness, and absence of involvement of the remainder of the vascular system.

Von Graefe [6] distinguished a central recurring retinitis of syphilitic origin from the ordinary syphilitic retinitis. It occurs in the center of the retina; there is a central scotoma, and there are a number of recurrences over a period of several years. It resembles other forms of central exudative choroiditis or retinitis. It is more resistant to antisyphilitic treatment than the usual forms of syphilitic retinitis. He

4. Danco, A.: Ueber doppelseitige Neuroretinitis stellata centralis nach Grippe, Klin. Monatsbl. f. Augenh. **67**:87, 1921.

5. Wirtz, R., and Liebermeister, G.: Plötzliche einseitige Erblindung infolge akuten Oedems der Netzhaut; zugleich klinische Bilder zur Entstehung "metazystischer Lochbildung der Makula" (Vogt), Klin. Monatsbl. f. Augenh. **69**:45, 1922.

6. von Graefe, A.: Ueber centrale recidivirende Retinitis, Arch. f. Ophth. **12**:211, 1866.

included it only among the more remote syphilitic phenomena. Long continued inunction therapy appears to be the only efficacious treatment. This does not cure the retinitis, but the attacks gradually cease. Restitutio ad integrum depends on the state of the functions in the intervals between the attacks and on the permanent disturbances in the tissue in the immediate macula. This form of retinitis is usually bilateral.

The following authors discuss the senile form of central retinitis, or rather that form seen more particularly in adults. Discussion of the adult or senile form is advantageous in helping to understand the juvenile form. The two are distinctly different and should not be confused.

Zentmayer [7] reported two cases of retinal disease with massive exudation which might be of the same type as that in the cases reported, though with different clinical manifestations. Collins and Mayou [8] considered massive exudation to be allied with retinitis circinata.

Discussing exudative retinitis, de Schweinitz [9] noted that the most prominent feature is a large yellowish-white lesion together with smaller areas lying below the retinal vessels. Its progress is slow and insidious, and it most frequently attacks young persons.

According to Coats, the disease has its inception in hemorrhages into the interretinal layers. It thus has many manifestations. As de Schweinitz further remarked, "the etiology is in doubt."

Marshall and Michaelson [10] reported four cases of exudative retinitis in childhood with the following characteristic features, which might apply to the case reported: (1) youth of the patient, (2) chronicity of the condition, (3) localization chiefly in the outer layers of the retina, (4) large bladder-like cells in the retina and subretinal space, (5) hemorrhages in only a minor rôle and normal vessels, and (6) a normal choroid and pigment layer.

Investigation suggests that clinical and pathologic differentiation exists between the following three different entities: retinitis exsudativa haemorrhagica of Coats, retinitis exsudativa senilis and retinitis exudativa serofibrinosa of Leber. The bladder-like cells which appear to be characteristic of these conditions are assigned many origins and many rôles by different authorities. Shaw Dunn of the University of Glasgow

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7. Zentmayer, William: Massive Exudate in Retina, Tr. Coll. Phys., Philadelphia **37**:411, 1915.

8. Collins, E. Treacher, and Mayou, M. Stephen: Pathology and Bacteriology of the Eye, Philadelphia, P. Blakiston's Son & Co., 1926.

9. de Schweinitz, G. E.: Senile Macular Disease: Its Evolution, Diagnosis and Treatment, Atlantic M. J. **31**:818 (Aug.) 1928.

10. Marshall, J., and Michaelson, I. C.: Exudative Retinitis in Childhood, Tr. Ophth. Soc. U. Kingdom **53**:102, 1933.

suggested that they are histiocytes, part of the reticulo-endothelial system, playing their usual rôle of scavengers.

E. Fuchs,[11] in an article on classification of retinitis, mentioned the tapetoretinal degeneration in adolescence, for instance, retinitis pigmentosa and retinitis albescens. According to him there are similar conditions occurring in persons of advanced age, and it is not possible to determine whether they also occur on the basis of an anomaly of development. To this group belongs the senile degeneration of the macula lutea, as in a few cases of this disease in which anatomic examination could be made the choriocapillaris was found to be normal. In this same article Fuchs said that the disk-shaped degeneration of the macular region is an acquired disease. It develops in persons of more advanced age and is usually bilateral. The anatomic change is a membrane between the retina and the choroid which is supposed to originate from the pigment epithelium and the capillaries of the retina.

Evans,[12] discussing retinitis of vascular origin, said that retinitis circinata and senile exudative retinitis are essentially lesions of the choroid primarily and that the retinal changes are of a degenerative nature and due to failure of the blood supply. Some authorities, he said, consider senile exudative choroiditis to be a manifestation of vascular disease of the choroid.

Junius and Kuhnt referred to a number of observations recorded in the literature which relate to changes in the macula lutea and are described under widely different names. As examples are mentioned "disciform degeneration of the macula lutea" (J. Oller), "tumor-like tissue proliferation in the macula" (Elschnig)[13] and "senile macular changes in arteriosclerosis" (Possek).

Several affected eyes have been enucleated owing to a suspicion of a tumor, and the benign character of the formation has been revealed only on microscopic examination.

Purely degenerative processes and noninflammatory phenomena appear in the foreground of the pathologic picture. These processes probably have their inception in the retina at the macula. Atrophy of the retina may take place, or thickening may occur with hemorrhages. Hemorrhages are concomitant symptoms of disease of the vessels supplying the central retina which naturally must affect primarily this portion of the retina, the macula, destined for the most delicate and highest physiologic function. The picture of a "disk" does not always result; on the contrary, the focus may be oval or of some shape of great irregularity.

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11. Fuchs, E.: Classification of Retinitis, Arch. Ophth. **3**:393 (April) 1930.

12. Evans, Philip J.: Some Aspects of Vascular Change in the Fundus Oculi and of Retinal Arteriosclerosis in Particular, Brit. J. Ophth. **17**:257, 1933.

13. Elschnig, A.: Tumorähnliche Gewebswucherung in der Macula lutea, Klin. Monatsbl. f. Augenh. **62**:145, 1919.

Sclerosis of the choroidal vessels under this lesion may occur, or the choroid may remain intact. Anastomosis may form between the retinal and the choroidal vascular system. Disease of the walls and variations in the caliber of the retinal vessels are only gradually perceptible, usually only when the disease itself is already far advanced. The authors assume that the invisible, fine branches running to the macula suffer from a disease of their walls prior to or with the onset of the malady.

The small hemorrhages are visible manifestations of the disease. Arteriosclerosis, alcoholism, syphilis and disturbances in the vasomotor system probably play a part. These authors think that the secondarily proliferated pigment epithelium might play an important part. They believe that an intimate relation exists between certain cases of retinitis circinata and discoid degeneration of the macula lutea.

Adler [14] discussed disciform degeneration of the macula of the Junius-Kuhnt type and reported a case. It will be observed that the type he discussed is the senile form and not the juvenile exudative retinitis of Junius. Emphasis must be placed on the difference in the senile type, which no doubt is of a degenerative nature, and the juvenile type, the etiology of which is as yet unknown.

SUMMARY AND COMMENT

There are numerous varieties of macular disease discussed by many authors. Considerable confusion exists as to their etiology. Classification into definite clinical varieties is possible in certain forms, Coats' disease for example. Junius has apparently established a definite clinical entity in the form described here, i. e., juvenile macular exudative retinitis. A careful search of the literature on the subject reveals no case described in this country and but a few in Europe. Apparently this form of exudative retinitis in youth has not been widely recognized.

The diagnosis of the disease may be based on the following criteria: youth of the patient, usually negative medical findings, extreme chronicity without great reduction of vision as compared to the appearance of the retinal lesion, a tendency to recovery of the vision earlier than cure of the lesion, so far as one may judge from the appearance of the latter, final recovery of normal vision with a normal or almost normal appearing macula and absence of hemorrhages such as are frequently seen in many macular lesions of other types.

Is this condition degeneration, inflammation, or a disease, or is it due, as Fuchs suggested, to an anomaly of development? Definite information can be had only when histologic and other investigations

14. Adler, Francis Heed: Disciform Degeneration of the Macula (Junius and Kuhnt), Arch. Ophth. **10**:379 (Sept.) 1933.

can be made. Until the condition is more widely recognized and reported, opportunities for such study will not be available.

ADDITIONAL CASE

Since reporting the foregoing case I have had, through Colonel Ralph H. Goldthwaite and Major Walter C. Royals of the United States Army Medical Corps, the opportunity of studying a second case, from the Army Medical Center at the Walter Reed Hospital. This rare and unusual case may possibly be included in the classification of juvenile macular exudative retinitis (Junius), since it occurred when the patient was 38 years of age.

CASE 2.—W. H., white, aged 41, was first admitted to the Walter Reed Hospital for diagnosis of an ocular condition on April 1, 1934, with the complaint of complete loss of central vision in the right eye and some impairment of vision in the left.

In August 1932, while doing clerical work in the Panama Canal Zone, he first had difficulty with his right eye by apparent distortion of the lines of his book. This became so marked that he consulted a physician, who could find no ocular pathologic process at the time. Six weeks later a dense cloud developed before the right eye, and vision became progressively worse until within from six to eight months after the initial metamorphopsia all central vision was lost.

A general medical survey revealed only chronic appendicitis; the patient was subjected to appendectomy in October 1932.

About March 1, 1934, he began to have a similar metamorphopsia in the left eye and again applied for treatment, fearing that his left eye would suffer a similar fate.

The patient was born in Nebraska. He is a churchworker, and he uses neither alcohol nor tobacco. As a child he had measles, mumps, scarlet fever and typhoid; otherwise he has had no serious illness. He was struck on the right eye by a tennis ball fifteen years ago and was told he had sustained a rupture of the retina. He remained in bed a few days, and vision returned to normal and remained so until the present illness. He said that he had never had a venereal infection. He has lived in Panama and Central America for the past four years.

His mother and father are living. The family history does not reveal tuberculosis or a malignant condition.

General physical examination showed a well developed but rather poorly nourished white man. The blood pressure was 124 systolic and 64 diastolic. No remarkable physical abnormalities were found. The urine revealed no pathologic constituents. The genito-urinary tract was normal as indicated by cystoscopic examination and a pyelogram. The Wassermann reaction was negative. The blood chemistry was normal. Neither physical examination nor roentgenograms revealed any abnormality of the chest. The ears, nose and throat were normal. The basal metabolic rate was —14. Dental examination gave negative results except for a residual root fragment, which was removed.

Ophthalmoscopic examination showed a normal-appearing disk in the right eye. Forming an anastomotic network throughout the fundus were the grayish purple-red angioid streaks, which were under the retinal vessels (fig. 6). They were flat and not elevated and in many places had irregular edges. They extended about as far forward as the equator and seemed to break up into irregular dark

spots. In the macula was a sharply circumscribed lesion, shaped like a ping-pong paddle with the handle temporally. It was elevated 3 diopters, and radial striations suggested tenting of the retina, because the retinal vessels passed over it. It was of a reddish tinge with a central depression surrounded by a yellowish ring. Above and adjacent to it, but level with the rest of the fundus, was a smaller yellow area and extending temporally from the "handle" was a yellow streak, while between these two areas and slightly separated from the main lesion was another small round yellow spot. Throughout the fundus the pigment was more pronounced than is usually seen, especially peripherally, where there were some dense black spots.

In the left eye the angioid streaks were similar but larger and less pronounced. The macula was reddish and granular; in its upper temporal part were several irregularly-shaped red splotches which appeared to be hemorrhages. There was a suggestion of elevation of the macular vessels. The fovea was indistinguishable. The visual acuity, under eucatropine, was 20/40—2, correcting to 20/20—4 with a +0.75 sphere.

TRAUMA AND RETINAL DETACHMENT

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AND
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It has long been a well known and uncontested fact that in cases of retinal detachment there is usually a hole or a tear in the retina, which is, moreover, the cause of the continuation of the detachment, closure of the hole usually resulting in a cure. Hence, in determining the origin of a retinal detachment, the question of the origin of holes and tears is of primordial importance. We have tried to form a theory concerning the etiology while awaiting a case in which the tear and detachment could be observed directly.

Recently we were able to observe the development of a horseshoe-shaped tear in one patient and to watch the consecutive changes preceding detachment of the retina in another patient. In Mr. W. P. (1931), in a small area at the top of the retina toward the temple, we saw three small oval holes; they lay practically in one retinal circle, i. e., almost at an equal distance from the ora serrata. At an examination made twenty-four hours later one fairly large horseshoe-shaped hole was found at this spot (fig. 1). This was a surprise to us, as we were accustomed to consider the horseshoe shape as being due to a tear and as proof of the traumatic origin of the detachment. After this observation we no longer felt justified in assuming from the horseshoe shape of the hole and the characteristics of a tear that an injury, i. e., traumatic accident, had occurred.

As a matter of fact, in many cases of horseshoe-shaped holes there is no question of trauma, and the origin of the tear just described, that of confluence of existing smaller holes, gives us an acceptable explanation of the picture presented by the fundus, as shown in figures 2 and 3.

This does not mean that mechanical factors do not play any part in the production of horseshoe-shaped holes, but it does prove that abnormal trauma need not be the cause. Neither can one assume that every horseshoe-shaped hole has the same origin. In some cases such a hole may develop from large cysts or be due to direct tearing away from a cicatrix resulting from choroiditis.

The picture shown in figure 1 is similar to one presented by Arruga in a report read before the International Ophthalmological Congress in Madrid in 1933 (fig. 83).

From the Ophthalmologic Department of the University of Amsterdam.

We by no means exclude trauma as a possible etiologic factor, but our observation shifts the problem to another phase in some cases. It gives rise to the question of to what extent the small round holes, this strange change in the retina, can be caused by trauma. The following case gave us an answer to this question:

Fig. 1.—*A, B* and *C* show the development of a horseshoe-shaped tear from three individual holes in the retina.

Fig. 2.—A typical horseshoe-shaped tear.

Miss X was hit with some force in the left eye by a ball, on Nov. 8, 1933. On November 25, an area of dull gray discoloration was seen in the fundus close to the periphery toward the temple in which were several small areas of hemorrhage, ostensibly the remnant of a commotio retinae—Berlin's disease (fig. 4). Moreover, in the middle of this gray region were seen two large round spots lying fairly close together and some small round spots of a brighter and more normal color, as if

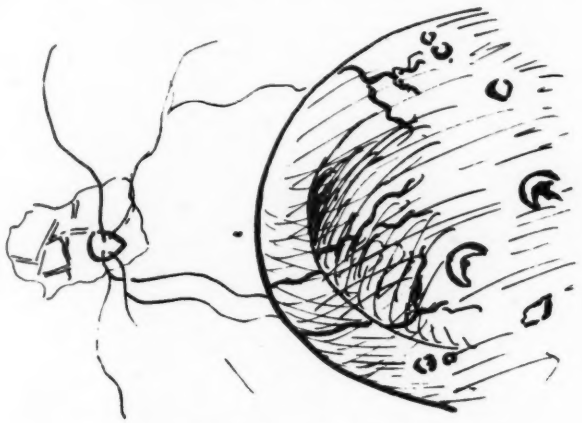

Fig. 3.—A typical horseshoe-shaped tear.

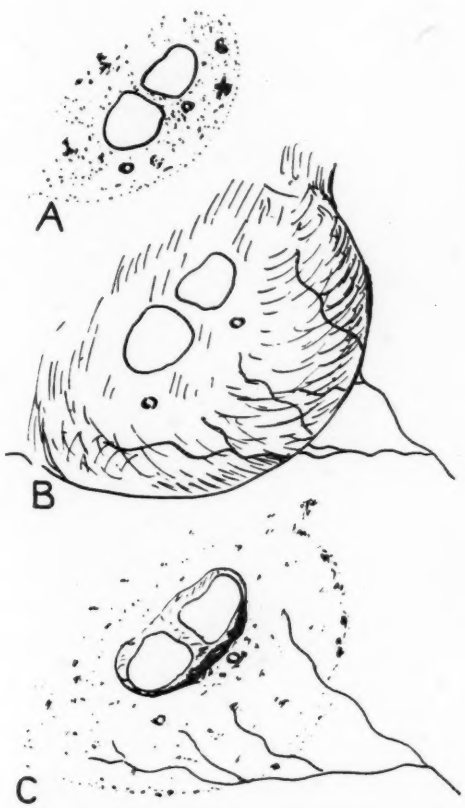

Fig. 4.—*A*, remnants of peripheral commotio retinae on Nov. 25, 1933. *B*, the condition on Feb. 3, 1934. A large balloon-shaped detachment was present. *C*, the condition on April 27, 1934. The detachment was no longer present, but there were still holes in the retina. Pigmentation had increased in the region of the healed detachment.

holes had been left open. There was no question of parallactic shifting or of raising or loosening of the retina. This fact was established with great certainty, because the nature of the trauma and the site and the character of these changes caused us to fear that a tear of the ora serrata might develop later. The patient was examined every fortnight and later every four weeks.

On Feb. 3, 1934, in the same area, a balloon-shaped detachment of the retina was seen, on which two large holes separated by a narrow bridge appeared to indicate the initial stage of a larger tear of the ora serrata. There was also a definite disorder in the field of vision corresponding to the location of the detachment. During the continual wearing of diaphragmated spectacles no further extension of the detachment was noted; it even improved, so that on April 27 the retina had almost completely reattached. A diffuse pigmentation in a sharply defined field, bounded by a fine convex line, revealed the cured detachment. Very near the surface the two great holes were seen to show some parallax and to be surrounded by a narrow gray edge on the top of a sharply defined elliptic detachment.

A few months later a similar observation was made on a man with less pronounced alterations and a smaller hole in the retina, which up to the time of this report has not been followed by detachment. In a boy, a few hours after a severe blow, Berlin's disease was observed; the next day small holes were seen and a few days later, a small but typical horseshoe-shaped tear near the temporal portion of the ora serrata.

Three other patients were observed who had a disinsertion of the ora serrata in an eye that until recently had been considered normal in every respect. In all three patients the eye had been subjected to a rather severe injury from a few months to a half year before the tear was observed, and the sight was affected. If the tears of the ora serrata were of an identical character, and if they all went through a phase the same as that in the first case, then the horseshoe-shaped tear and the tear or disinsertion of the ora serrata in the cases mentioned here were genetically identical, i. e., not of direct traumatic origin; at the moment of the beginning of the horseshoe-shaped tear or of the hole in the ora serrata only physiologic forces were active; the preceding retinal changes were possibly due to trauma.

The observation just described illustrates this last fact and proves that the way in which trauma produces commotio retinae is also the manner in which it paves the way for detachment.

The structural changes excited by commotio retinae evidently represent one of the initial stages of those greater changes which may be followed by tearing and detachment or predispose the eye to their development.

There is naturally a mechanical explanation for the pathogenesis of commotio retinae. One is confronted by the consequences of a mechanical force which even the normal structural cohesion of the retina cannot withstand. This force undermines and weakens the normal

structural cohesion to such a degree that it no longer resists physiologic forces, and dehiscences, holes and tears result.

Various observers are of the opinion that the "retinal edema" which is observed in cases of commotio retinae after contusion of the globe is the result of a circulatory disturbance, vascular paralysis or spasm of the retinal vessels (Ostwald, Siegfried, Lindner and Roscin) or of both (Wagenmann). Parsons [1] stated: "That the essential cause of the oedema lies in the condition of the vessels is shown by Wagenmann's experiments."

Dufour and Gonin saw distention of the arteries following trauma from a blow, and Leber wrote that he observed slight redness of the papilla in two patients and slight distention of the retinal vessels in another patient.

Roscin expressed the opinion that in cases of commotio retinae in which severe hemorrhages and tears are not present a combination of tearing of the tissues of the retina and enlargement of the retinal blood vessels is sufficient to explain the ophthalmoscopic picture.

None of the investigators mentioned here, however, has given an explanation of the fact that the aspect of the retina in cases of commotio retinae has a particular character and hence can be easily distinguished from retinal edema by an experienced examiner. This unmistakable difference in appearance prevents one from identifying it with edema after ischemia of the retina or in the vicinity of the centers of inflammation, while concrete examples of vascular paralysis and cases of opacity of the retina dependent on that are scarcely known.

Insight into the nature of traumatic retinal opacity is therefore not made in the least clearer by considering it identical with the presumed but seldom observed consequences of vascular paralysis. We do not consider any of these vascular theories supported by sound example; neither do they give a satisfactory explanation of the peculiar picture of the fundus. As a matter of fact, Leber has already pointed out this fact and has rejected these theories.

Structural cohesion is a function of the supporting tissue of the retina and also of the surrounding tissues so far as they are connected with the supporting tissue, that is to say, of the outer layers of the vitreous in its foremost part.

The actual supporting tissue consists of Müller's fibers and *Spinnenzellen* (neuroglia cells). Müller's supporting fibers stand between the membrana limitans interna and the membrana limitans externa like so many columns which carry and hold together the retinal elements, together with numerous smaller glia cells, the thin fibrils of which encircle nerve fibers, ganglion cells and granular cells and dissolve into a kind

1. Parsons, J. H.: The Pathology of the Eye, London, 1908, vol. 4, p. 1161.

of limiting layer (membrana limitans perivascularis) against the walls of the blood vessels (Krückmann). The broad ends of Müller's fibers, their cuticular thickened *Basalplatten* (basal plates), unite into a continuous limiting membrane, which extends into the cuticle of the ciliary epithelium. This layer, which by reason of its continuity resembles a boundary, a frontier between territories of different structure, can derive some strength from the solidity of its cellular construction. Yet we agree with Leber in considering the connection of the retinal elements translaterally looser than between its layers.

Denig, with his experiments, not only refuted Berlin's idea that the picture of commotio retinae is connected with a subretinal hemorrhage but observed strange bumps reminiscent of a chain of pearls on the inner surface of the retina which made him presume that there were distention of Müller's fibers and small tears in the membrana limitans. Beginning detachment of this layer must, according to Lohmann, too, be the cause of the picture in cases of commotio retinae. Leber further pointed out that it has always been designated incorrectly as edema, that it is of no use to indicate the source which should produce the edema (in older theories, the vessels; in Denig's theory, the vitreous) and that in any case a swelling opacity is a much more suitable term. Microscopic tearing of the tissue elements, secretion of myelin, with its well known swelling capacity, a granular, intensely white opacity and rapid resorption are the bases of the picture.

Differences in degree, greater distention of the retinal elements, wider tearing of the membrana limitans and tearing of the thickened outer layer of the vitreous create the conditions which, according to clinical observation, may later lead to the formation of a hole or to detachment. The case of Miss X is an example of this. This case supports the theory accepted by Leber that a detachment following contusion can sometimes develop gradually in from four to eight weeks, but the case also belies Leber's statement that such detachment is always the result of a peripheral tear, which draws away from the eye, and that the detachment develops gradually. Our examination of this patient showed that originally there was no large tear but only diffuse delicate alterations, while the actual wide tear developed later.

This observation taught us (1) that the time that elapses between the onset of the lesion and the detachment, which is its indirect consequence, may be quite long; (2) that the retinal alterations which may at first be observed in the ophthalmoscope may be rather diffuse, spotted and cystic but hardly characteristic of the changes produced by trauma, and (3) that an eventual tear or detachment of the ora is not always the direct consequence of trauma.

This does not mean, of course, that serious trauma cannot cause a tear in the vicinity of the ora serrata. Leber observed this in a man

42 years of age in whom the entire lower half of the retina was raised like a bladder three days after he had been violently struck in the eye and the retina had torn away widely at the periphery.

The eye of Miss Fl. was injured by a stone; prolapse of the iris was corrected. The vitreous was opaque owing to severe bleeding. After two weeks a rupture of the choroid was seen near the papilla, and a few weeks later a large tear at the ora serrata. It seemed obvious, though not certain, that the latter occurred at the time of the accident..

The similarity between tears of the ora serrata and horseshoe-shaped tears, whether of traumatic origin or not, gives rise to the question whether physiologic forces can produce detachment after a prolonged or repeated action, and whether the retina with a beginning detachment or lacuna can tear by physiologic forces.

The facts related make it probable that there are only differences in degree between the apparently widely different traumatic and spontaneous retinal detachments.

In proportion to the trauma (violent, moderate, slight or physiologic) and according to the structural resistance of the supporting tissue of the retina (slight, increased or normal), a direct tearing or beginning commotio followed by small holes, and later tearing may lead to complete detachment sooner or later in a weak or normal eye.

These conclusions are of importance practically with a view to accident insurance and theoretically for insight into the pathogenesis of retinal detachment.

From the standpoint of accident insurance, it is important to know that serious and moderately serious injuries to the eye may be held responsible for the development of retinal detachment regardless of whether the detachment occurs immediately or months after the lesion. Weymann [2] wrongly accepted Davidson's suggestion that all cases in which the injury was proved, complaint of subjective signs was made within two days and retinal detachment occurred within two weeks he considered compensable. Von Hippel's statement that "ein angeblicher Unfall erst nach langer Zeit Netzhaut Ablösung geben könne, sei vollig unglaubhaft" (that an alleged accident would cause detachment of the retina only after a long period, would be unbelievable) is in our opinion refuted by our observations and in any case could not be strictly maintained. This has been pointed out before, and insurance companies make their decisions accordingly, as one of us (H. J. O.) observed in an article on traumatic retinal detachment, when discussing the cases in category C.[3]

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2. Weymann, M. F.: Traumatism in Retinal Detachment, Am. J. Ophth. **16**:733 (Aug.) 1933.

3. Oltmanns, H. J.: Tydschrift der Ryksverzekeringsbank, 1931.

If trauma is too slight to cause commotio retinae, i. e., too slight to give rise to beginning detachment and the predisposition to complete detachment, it is impossible to assume that detachment that originated weeks or months later is due to this trauma.

If slight trauma is followed immediately or at least very soon by detachment, one must assume that the eye was not normal and that the trauma was just strong enough to make the retina tear. Cases of this type were grouped in category B [3] in the previously mentioned article, i. e., cases for the most part in myopic eyes in which even physiologic trauma may cause detachment, as was often shown by later detachment in the second eye. In such cases the possibility of spontaneous tearing and detachment under the influence of physiologic forces must be recognized, and the part played by the accident may be considered of particular significance and admissible only if the active forces are decidedly superior to the forces normally at work. It is the nature and violence of the injury which must here decide whether the injury is a real one. Von Hippel [4] expressed the same opinion that "das angebliche Trauma deutlich aus dem Rahmen der täglichen Arbeit herausfalle" (the alleged trauma must be due to forces greater than those involved in the daily work).

For this category, too, we are in complete agreement with the conclusions arrived at previously.[3] Categories A and D need not be discussed here because the observations outlined by us open no new vistas.

The relationship of the various traumatic and spontaneous forms makes it probable that the point of attack and the transference of the active forces (pathologic or physiologic) differ little if at all. The point of attack must lie in the supporting tissue of the retina. Only structures which are normally attached to the retina transfer forces to it, and these are the anterior parts of the vitreous and the zonular fibers, that is, the very elements which play an important mechanical part in the physiologic accommodative mechanism. It is probable that the zonular fibers and the structures in the anterior parts of the vitreous show the lines of force and direction along which the active forces and the finer tissue shiftings connected with those active forces travel when the accommodative mechanism is brought into play, but these lines and forces must also be recognized as a menace to the retina, constructed as it is for some other function. There is an incongruity in the requirements seemingly made of the retina. The retina in a more limited sense, the sensitive derivative of the optic vesicle and part of the central nervous system, is in this instance passive; it does not bear but is borne; it scarcely resists but does not succumb. The skeleton of supporting tissue against

4. von Hippel, E.: Ueber meine bisherigen Ergebnisse bei der operativen Behandlung der Netzhautablösung mit Bemerkungen über traumatische Netzhautablösung, Klin. Monatsbl. f. Augenh. **92**:145 (Feb.) 1934.

and in the retina and along its vessels is *in casu* the important part in question here. This bears, resists, gives way and tears. It is not proved and is at least doubtful whether the Blessing grooves in the retina near the ora serrata may be called predisposing elements for tearing and detachment. This may be conjectured only so far as they are the consequence of or are accompanied by congenital or acquired weakness of the supporting elements, of Müller's fibers and the membrana limitans interna, of the glia coat and connective tissue along the vessels, of the fibrous, thickened outer layer of the vitreous, of the membrana hyaloidea posterior and of the connections between these various elements.

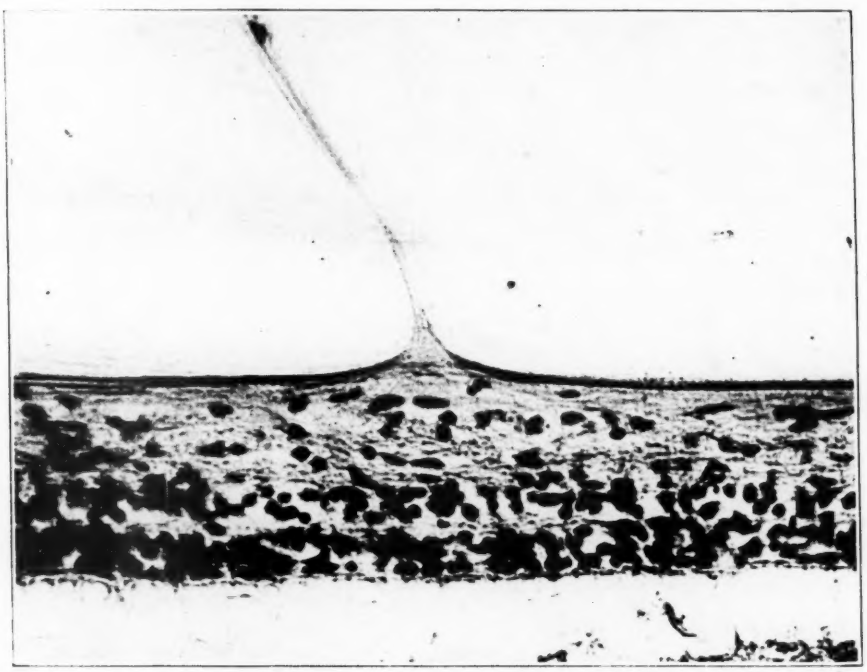

Fig. 5.—The connection between the membrana hyaloidea and the membrana limitans interna.

Figure 5 shows a diagram of the coarser connections which exceptionally may be found among innumerable more delicate ones; their functional vitality seems to find expression in some cells rightly brought to the fore by Lashley and Weve between the membrana hyaloidea and the membrana limitans interna.

Tearing of the membrana hyaloidea and of the membrana limitans interna means tearing of the intraretinal supporting tissue and hence the first step to detachment of the retina. No wonder that the edges of the retinal tear often seem to lie in the normal retina even if there is a serious decrease in thickness in the immediate vicinity. Therefore, pre-

disposing factors for complete detachment appear to be all those factors which cause a delicate structure (congenital), distention (myopia, not accommodating), fragility (senility, inflammation) and beginning detachment (commotio retinae, vibrations, a fall or head trauma) and thus promote the development of a tear of the membrana hyaloidea posterior.

The reactive phenomena along the walls of the torn vitreous appear to confirm the great significance of this tear but can only rarely prevent the consequences (retinitis proliferans, hemorrhage or preretinitis) and never restore them.

BILATERAL CONGENITAL DEFICIENCY OF ABDUCTION WITH RETRACTION (DUANE SYNDROME)

REPORT OF A CASE

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CAMDEN, N. J.

This syndrome associated with congenital deficiency of abduction was described in detail by Duane [1] in 1905 after he had collected reports of fifty-four cases, five of which were cases of bilateral deficiency. Prior to that a number of cases had been reported by Sinclair,[2] Türk,[3] Bahr,[4] Friedenwald [5] and Treacher Collins,[6] and a complete discussion of the symptoms had been presented by J. Wolff [7] in 1900 and by Evans [8] in 1903. More recently Harold Gifford,[9] Bielschowsky [10] and Birch-Hirschfeld [11] have presented full descriptions of this complex syndrome.

The syndrome is characterized by : (1) deficiency of abduction, (2) partial deficiency of adduction, (3) retraction of the globe when the eye is adducted, (4) oblique movement when adduction is attempted, (5) narrowing of the palpebral fissure during adduction and (6) deficiency of convergence.

A varied clinical picture is presented by this syndrome, some features being more constant and more marked than others. Deficiency of abduction is the most constant finding. In most cases there are retraction and narrowing of the palpebral fissure. The oblique movements of the affected eye during adduction, the partial deficiency of adduction of the affected eye and the deficiency of convergence are not present in

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Read before the Section on Ophthalmology, College of Physicians, Philadelphia, Nov. 15, 1934.

1. Duane, Alexander: Congenital Deficiency of Abduction, Arch. Ophth. **34**: 133, 1905.
2. Sinclair, W.: Ophth. Rev. **14**:314, 1895.
3. Türk, S.: Deutsche med. Wchnschr. **22**:199, 1896.
4. Bahr: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. **25**:334, 1897.
5. Friedenwald, H.: Bull. Johns Hopkins Hosp. **8**:135 and 202, 1896.
6. Collins, E. T.: Brit. M. J. **2**:846, 1899.
7. Wolff, J.: Arch. Ophth. **29**:297, 1900.
8. Evans, J.: Ophth. Rev. **22**:1, 1903.
9. Gifford, H.: Congenital Defects of Abduction and Other Ocular Movements and Their Relation to Birth Injuries, Am. J. Ophth. **9**:3, 1926.
10. Bielschowsky, A., in Graefe-Saemisch: Handbuch der gesamten Augenheilkunde, Leipzig, Wilhelm Engelmann, 1932, vol. 8, pt. 2, chap. 11, p. 353.
11. Birch-Hirschfeld, A., in Graefe and Saemisch: Handbuch der gesamten Augenheilkunde, Leipzig, Wilhelm Engelmann, 1932, vol. 9, pt. 1, chap. 13, p. 220.

every case. Retraction of the globe was not present in some of Duane's cases.

A large number of cases of unilateral deficiency have been reported, and doubtless an equally large number have been seen and not reported. The bilateral type is much less frequently seen, which is surprising since other congenital anomalies of the eyes are frequently bilateral. The number of cases of bilateral deficiency that have been reported in the literature is sixty-seven, some of which were borderline cases. In the cases of unilateral deficiency 60 per cent of the patients were females, whereas in the cases of bilateral deficiency the number of males and females affected was about equal. About 33 per cent of the cases of bilateral deficiency were complicated by facial paralysis, but in the cases of unilateral deficiency this complication was seldom present.

The deficiency of abduction is accounted for generally by the replacement of the external rectus muscle with fibrous cords. Variations in the syndrome are due to the fact that (1) the cordlike external rectus muscle sometimes has more muscle fiber elements than usual; (2) the internal rectus muscle is abnormally inserted, and (3) is abnormally fibrous and rigid.

Among the etiologic features injuries sustained at birth were stressed by Harold Gifford.[9] The frequency of facial paralysis in the cases of bilateral deficiency may be indicative that the deficiency of abduction has its origin in the central nervous system. In some cases there are other congenital anomalies due to defective development.

REPORT OF CASE

B. T. was seen first when she was 5 years of age. At that time there was a slight crossing of the eyes, and some difficulty in looking to each side. This condition had been present from birth, which was normal, at full term and without instrumentation. There were no abnormalities in the parents, grandparents or other relatives.

She had had no head injury. Of the various diseases of childhood she had had measles and chickenpox.

She was a normal child, alert mentally, showing no other stigma or congenital defect. Externally, the eyes appeared to be normal except for a slight degree of convergence; the pupils were equal, reacting to light and in accommodation. There was complete limitation of external rotation in each eye. The lids were normal in appearance and motility. No facial paralysis was detected.

Ophthalmoscopic examination showed that the fundus of each eye was granular. In the right eye there was a dark, circular area of choroiditis, with a diameter equal to one third of that of the disk, on the nasal side of the head of the optic nerve. Otherwise, both eyegrounds were normal.

The refractive error consisted of a moderate amount of compound hypermetropic astigmatism, which was slightly more marked in the right eye. With this correction, vision was 6/6 in each eye.

There had been no diplopia at any time. In the primary position, the eyes were slightly convergent. When an attempt was made to rotate the eyes to the right,

when looking at an object on the right side the left eye was the fixing eye and the right eye failed to rotate past the midline. When an attempt was made to rotate the eyes to the left, the condition was reversed; the right eye became the fixing eye and the left eye failed to rotate past the midline. There was an alternating monocular vision depending on the side to which the eyes were rotated and which eye was the fixing eye.

When abduction was attempted, there was no rotation past the midline with either eye. Arching and elevation of the eyebrow accompanied the attempts at abduction. There was a widening of the palpebral fissure when a strong effort was made to rotate either eye outward. It was apparently difficult for the child to rotate either eye inward freely, although with effort this was accomplished. When the eye was rotated inward, the globe was retracted 2 mm. and the palpebral fissure

Bilateral congenital deficiency of abduction with retraction. *A* shows the position of the eyes in the primary position, looking straight ahead. In *B*, in attempting rotation to the left the left eye fails to rotate past the midline and the right eye is the fixing eye, with retraction and narrowing of the palpebral fissure of the right eye in adduction. In *C*, in attempting rotation to the right the right eye fails to rotate past the midline, and the left eye is the fixing eye, with retraction and narrowing of the palpebral fissure of the left eye in adduction.

was narrowed 2 mm. A slight upward and inward rotation of the eye was noted at times when an especially strong effort was made to adduct it. There was a deficiency of convergence.

The association of arching of the brow, or contraction of the frontalis muscle, with abduction of the eyeball was noted by William Zentmayer [12] in 1915, when he reported a case and referred to one other case in the literature by Wilbrand and Sänger in "Die Neurologie des Auges."

12. Zentmayer, W.: Ann. Ophth. **24**:30 (Jan.) 1915.

Operative treatment in cases characterized by this syndrome has been tried, but with little success in most instances. In cases in which there are esotropia and diplopia, operative measures are helpful. When there is an annoying diplopia with tilting of the head, a moderate recession of the internal rectus muscle has been advised. Operation was not advised in the case just described, as there was no annoyance from diplopia or head tilting.

SUMMARY

A case is presented in which there were a bilateral and complete deficiency of abduction, retraction of the globe, narrowing of the palpebral fissure, difficulty in adduction and deficiency of convergence. There were no other congenital defects, birth injuries or evidence of facial paralysis.

DISCUSSION

Dr. William Zentmayer: About twenty-five years ago, I reported a case of this syndrome. Since then, I have seen many cases. The most interesting ones were 3 cases occurring in three generations of the same family: the child, its mother and the maternal grandmother.

Dr. Warren S. Reese: I recall a case in which there was fairly good convergence and, on converging, both eyes retracted in the orbits and both palpebral fissures became narrower.

INFRA-RED PHOTOGRAPHY OF THE EYE

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The solar spectrum is divided by physicists into a visible spectrum and ultraviolet and infra-red rays. The wavelength of the rays in the visible spectrum ranges between approximately 400 and 700 millionths of a millimeter, the red rays having the longest wavelength and the orange rays the next longest; then follow the yellow, green and blue rays until the violet rays are reached at the opposite end of the spectrum from the red rays. Rays with too short a wavelength to appear in the visible spectrum follow the violet rays and are called ultraviolet. Rays longer than the red rays have the quality of "heat rays"; they do not appear visible to the human eye and are known as infra-red rays.

In ordinary photography, as practiced for many years, only the visible spectrum is employed, the finished picture thus showing exactly what is seen by the human eye. One of the newer developments in this field has been the utilization of the ordinarily invisible infra-red rays with specially sensitized plates and a filter which permits these rays to pass but occludes visible rays to which the plates are also sensitive. The original application of this method was made in aerial photography, especially in the presence of fog or haze. This use is based on the principle that the reflection and bending of light by small particles are dependent on the wavelength of the light; the longer the wavelength the less the dispersion of the incident ray through bending. A cloudy medium therefore becomes more transparent as the wavelength of the light is increased toward the red end of the spectrum, becoming clearest when the infra-red rays are reached, provided photography is utilized, since the human eye is not sensitive to these rays. In an infra-red photograph, fog, haze and clouds are not seen, but what lies behind them is registered on the photographic plate and may be clearly seen.

Particular use has recently been made of infra-red photography in medical cases, especially in the study of cutaneous conditions and in the visualization of the superficial venous system. A number of reports on the use of infra-red photography in this field appear in the literature, although the investigation cannot as yet be said to have passed the theoretical stage. Massopust [1] called attention to the appearance of

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From the Department of Ophthalmology, Northwestern University Medical School.

1. Massopust, L. C.: Infra-Red Photography, Radiol. & Clin. Photog. **10**:4, 1934.

infra-red photographs as contrasted to those made with panchromatic or orthochromatic plates in the ordinary manner. The flesh appears chalky, the red lips are light and all the lines of the face are greatly emphasized. The superficial veins stand out prominently and can be studied in detail owing to the semitransparency of the overlying skin. Profuse hair is said to obscure the underlying structures and should be removed when present.

Dekking [2] has used infra-red photography for the eyes and has demonstrated that the rays pass readily through the completely opaque cornea just as they do through haze and fog. This has made it possible to utilize this form of photography in diagnosis—a rare example of a finished picture showing what cannot otherwise be seen. The state of the pupil, the presence of synechiae and the existence of defects in the iris, either congenital or operative, can thus be determined in an eye with a dense corneal opacity. This should be of considerable practical value, especially when corneal transplantation is contemplated, and may thus be of aid in estimating a prognosis. Dekking [3] further called attention to the special features of the eye as viewed in the infra-red photograph. The pigment in the human iris reflects strongly the infra-red rays, forming a protective barrier against its absorption by the eye. The same is true of the pigment in the skin, so that Negroes appear pale and waxy in an infra-red photograph. The chlorophyll of the plants was also found by Dekking to have this characteristic, and he considered it to be analogous in protecting the organism from the harmful "heat waves." This same characteristic extends to a certain degree to the visible red rays. This reflection by the pigment of the iris must always be borne in mind in examining an infra-red photograph of the eye. A darkly pigmented iris will appear lighter in color than a light blue iris. In an atrophic iris the atrophied portion appears darker than the pigmented areas. The pupillary margin can be seen distinctly in a dark iris, whereas this is not usually the case, since by ordinary photography the iris and the pupil register nearly the same. These facts have some practical value in photographing the anterior segment of the eye, and the peculiar property of the pigment of the iris in reflecting the infra-red rays rather than absorbing them must be remembered in attempting to interpret such pictures properly.

Kugelberg [4] has photographed the fundus with infra-red rays and has published photographs taken by this method as well as with blue light and yellow light, the usual Nordensen fundus camera being used.

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2. Dekking, H. M.: Infrarotphotographie des Auges, Arch. f. Ophth. **130**:373 (Aug.) 1933.

3. Dekking, H. M.: Infrarotphotographie des Auges, Arch. f. Ophth. **133**:20 (Nov.) 1934.

4. Kugelberg, Ingemar: Der Augenintergrund in Infrarotem Licht, Acta Ophth. **12**:179, 1934.

He concluded that this has a theoretical interest but is of little practical aid in the diagnosis of conditions of the fundus. He was led to undertake his investigation by the possibility of visualizing the fundus photographically in cases of cataract as an aid in the prognosis of extraction of the lens. It is true that theoretically it would be possible to photograph the fundus through a cataractous lens and determine the presence of a pathologic process in the choroid, retina and optic nerve, since the infra-red rays pass through an opaque lens the same as they do through the opaque cornea. However, even if one were able to overcome all the technical difficulties, and they are many, the information gleaned would be of questionable value since cloudings, hemorrhages and even changes in the papilla are not readily diagnosed and differentiated in the infra-red photograph.

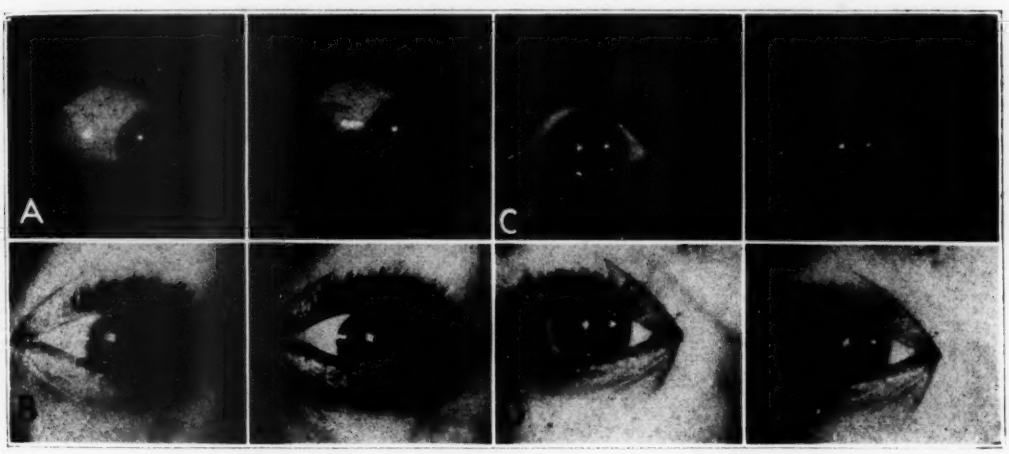

Fig. 1 (case 1).—*A*, photograph of the left eye with a panchromatic film in a case of old bilateral parenchymatous keratitis contrasted with an infra-red photograph (*B*) of the same eye. *C* and *D* show the right eye photographed with the panchromatic film and the infra-red method, respectively.

The practical utilization of infra-red photography in ophthalmologic practice, therefore, seems limited to the visualization of the anterior portion of the globe, especially in cases of corneal opacities in which no other means of examination will reveal abnormalities of the iris and pupil. That further developments in this field may enlarge the application of the method as an aid in diagnosis seems not unreasonable. The study of cutaneous conditions by infra-red photographs is in its incipiency, but the extensive work now being undertaken in this field may be productive of information of value relative to dermatologic conditions about the eyes.

A number of photographs are presented showing the appearance of the eyes as seen by the naked eye and as recorded with panchromatic

films, and contrasted with this are the results obtained when the eyes are photographed by the infra-red method. In case 1 (photographs were made through the courtesy of Dr. G. W. Nethercut) the eyes presented an old parenchymatous keratitis with such dense corneal scars that no view of the iris or pupil was obtainable on examination, although they appear readily in the infra-red photograph. The patient was a Negro, and the contrast in the pigment of the skin in the infra-red photograph as compared with that in the panchromatic picture is noteworthy. In case 2 (the patient was referred for photography by Dr. T. D. Allen) there is an even denser corneal opacity in each eye, in which many superficial blood vessels are well seen in the ordinary photograph. Case 3 (the patient was seen through the courtesy of Dr. J. E. Lebensohn)

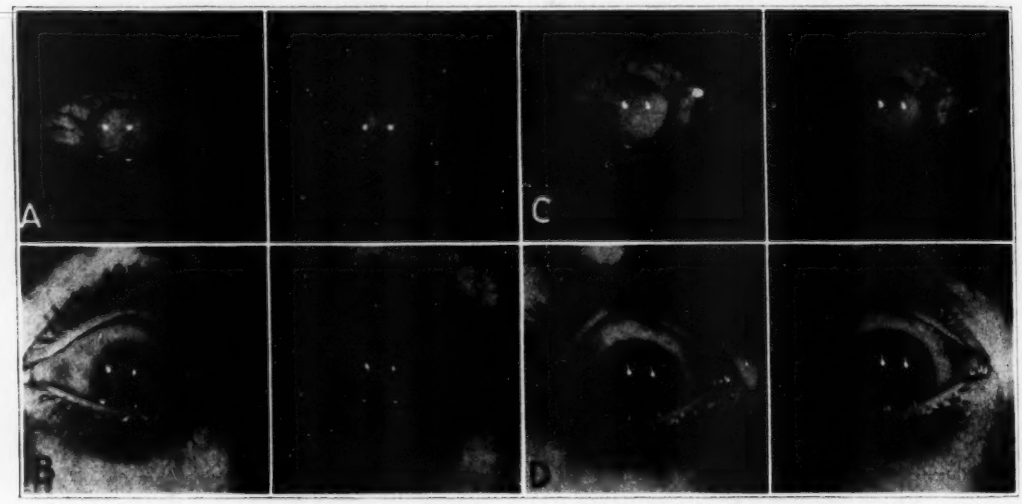

Fig. 2 (case 2).—*A*, photograph of the left eye with a panchromatic film in a case of dense corneal opacity contrasted with an infra-red photograph (*B*) of the same eye; *C*, the right eye, panchromatic film; *C*, the right eye, infra-red method.

is one of corneal dystrophy. The photographs in case 4 (that of a patient of Dr. S. R. Gifford's) show a dense corneal leukoma in which there has been a previous tatooing with india ink, the latter also registering in the infra-red photograph. The photographs in case 5 show a mature senile cataract and demonstrate that the infra-red rays pass through an opaque lens. Contrasted also is the appearance of the iris in the two photographs, owing to the behavior of the pigment in infra-red photography, as previously mentioned. These pictures all show to best advantage when viewed stereoscopically. Further experience with the method should result in some improvement in technical details, but these illustrations well indicate the possibilities presented.

Any camera satisfactory for external photographs of the eye may be used for infra-red pictures, and no special equipment is required except an infra-red filter to be placed in front of the lens of the camera and specially sensitized plates. Certain precautions must, however, be

Fig. 3 (case 3).—*A*, photograph of the eye with a panchromatic film in a case of corneal dystrophy contrasted with an infra-red photograph (*B*) of the same eye.

Fig. 4 (case 4).—*A*, photograph of the eye with a panchromatic film in a case of dense corneal leukoma contrasted with an infra-red photograph (*B*) of the same eye.

observed. The stereoscopic anterior segment camera manufactured by Bausch and Lomb was found satisfactory. There is considerable advantage to the stereoscopic feature, which renders the details more readily recognizable, especially when the media are especially opaque and the

details slightly obscured. This camera is equipped with two automobile headlight bulbs which can be focused on the eye from stationary points on either side, the illumination being maintained at a constant distance from the eye in all cases. A magnifying ocular lens aids in exact focusing and, being separate from the camera lenses, does not interfere with the use of the filter at the same moment that focusing is being undertaken. If focusing is done on a ground glass with the camera lens, the filter may be placed in position after focusing is completed. If a picture with greater enlargement than that ordinarily obtained is desired, a portrait attachment may be added to the camera lens. A convex lens of 4 diopters fitted over the lenses of the anterior segment

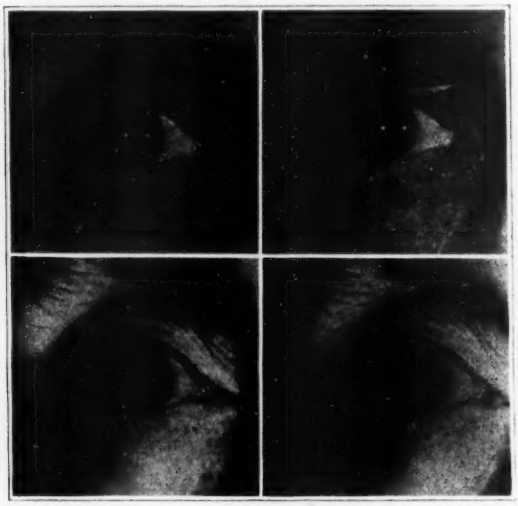

Fig. 5 (case 5).—*A*, photograph of the eye with a panchromatic film in a case of mature senile cataract contrasted with an infra-red photograph (*B*) of the same eye.

camera has been found to work satisfactorily in all photography of the anterior segment of the globe.

The filter used is the Wratten no. 25. The plates are the specially sensitized Eastman infra-red plates, type 1-R. These plates are sensitive to the blue and violet rays, but not to the red and green rays, the sensitivity reappearing in the invisible spectrum near the infra-red rays, reaching a maximum at a wavelength of 8,200 angstroms. The purpose of the filter is to remove from the light the visible rays to which the plate is sensitive (blue and violet), permitting the infra-red and the visible red rays to pass through. It is essential to handle these plates completely in the dark in loading, unloading and developing. Plate-holders must be used which will not transmit the infra-red rays. Some

of the older types of plateholder slides will do so and, of course, ruin any attempts at this type of photography. The hard rubber slides manufactured by the Eastman Company are satisfactory.

The time of exposure required will vary with the camera used and with the amount of infra-red rays in the source of illumination. With the camera and lighting described, the average time of exposure is about one second. The usual time of exposure for black and white pictures with this camera is about one-fourth second when supersensitive panchromatic films are used, or one-tenth second with double-coated orthochromatic plates. With this apparatus Agfa color plates also require about one second when no filter is used. With other cameras and illumination a trial will of course be necessary to determine the correct exposure.

VISUAL ALLERGY TO LIGHT AND INTOLERANCE TO LIGHT

TREATMENT BY TINTED LENSES

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Bray [1] quoted Duke as having recorded numerous instances in which such allergic manifestations as asthma and urticaria were due apparently to a specific sensitivity to the action of a physical agent, such as heat, cold, light or mechanical irritations.

Ophthalmologists have long recognized that certain patients are sensitive to light ordinarily tolerated by the average normal person. The person with a high degree of myopia frequently complains of the discomfort of reflected sunlight to which the person with hyperopia is tolerant, but frequently persons with normal sight become unusually sensitive to artificial light, the intensity of which is only a small fraction of that of daylight.

Many persons during night driving are disturbed by the lights of cars which are readily tolerated by most automobilists. In the psychopathic person, photophobia to ordinary light frequently develops, whereas the patient with dementia or with cerebrospinal syphilis has a high tolerance to light (Argyll Robertson pupil, which is inactive to light).

The patient with tumor of the brain has disturbances in light reception, and the sufferer from migraine becomes sensitive to light. The patient convalescing from a long illness complains of ocular symptoms, principally of ocular fatigue caused by light. Neurasthenic persons have been found to suffer from photophobia, and odd forms of facial tic and blepharospasm in children are precipitated by sensitivity to light.

Patients may be sensitized to light experimentally by the intravenous injection of minute quantities of hematoporphyrin (Bray [1]).

Clinically, there actually exists an ocular light allergy. It is principally a physical allergy, not in any way related to immunologic sensitivity but certainly related to urticaria solaris and to urticaria dermatographia. It is not an allergy in the sense that there exist antibodies or reagins which are clinically foreign to the tissue cells.

There is a possibility, however, that in certain pathologic states the apparatus of the visual pathways for light reception may be rendered

1. Bray, George W.: Recent Advances in Allergy, Philadelphia, P. Blakiston's Son & Co., 1931.

sensitive to light or to its spectral parts, and a true allergy to light, not physical but chemical, may occur, as in migraine.

In this study I wish to stress physical allergy to light, because of its common but unrecognized occurrence. No reference is made in this paper to invisible rays of light which require the use of protective goggles in industry.

Heretofore, ophthalmologists and physicists have used the term "glare," but they have failed to relegate a large share of ocular sensitivity to physical light allergy.

Tolerance or intolerance to light should not be confused with physical allergy to light. The first condition deals principally with quantitative endurance, whereas the second concerns only the effect of the usual daylight and artificial illumination, not alone on the eye in the form of conjunctivitis, ocular fatigue, photophobia, blepharospasm or headache but reflexly on the entire nervous system, as manifested by nervous irritability, general fatigue and easy physical exhaustion.

Quantitative tolerance and intolerance to light may be demonstrated by strong reflected light at sea, at the seashore and from snow. The quality and intensity of light are accepted differently in various persons and with a wide range of tolerance. Light allergy applies only to sensitivity to quantities and qualities of light less than those to which a reaction is shown by the average normal person.

The albino and the person with moderate or high myopia are as allergic to light as is the child who by heredity manifests the hypersensitivity of his parents. Albinos and myopes have a hereditary background.

Glare in its broadest sense is unwanted light. This term should be subdivided to include ordinary light to which the person with physical allergy to light is sensitive and extraordinary or intense light to which the person with intolerance to light is sensitive.

As ordinary light one must agree to designate the sunlight or daylight common to one's place of residence and artificial light from the common sources of illumination, such as electricity and gas, encountered in the person's everyday life. The city dweller may be intolerant to the sunlight on the farm, and the farmer to the bright lights of Broadway, but when the farmer cannot tolerate his own daylight and the city dweller the illumination common to his environment, they may both be considered to have physical light allergy.

RELATION OF PIGMENT TO TOLERANCE TO LIGHT

Through the many centuries of human life the eye has been developed to adjust itself to daylight and to the darkness of night. Exposed daily to sunlight of an approximate intensity on the ground of 9,000 foot-candles and in the shade of 1,000 foot-candles, the eye also has

been trained to adapt itself to seeing at night, with or without illumination by the moon and stars. Necessarily, the human eye adapted itself to these great extremes in the power and force of light by an anatomic make-up in the form of a deposit of pigment and by the physiologic development of a nervous mechanism tuned to tolerate the conveyance of light of great and of very low intensities.

The deposit of pigment in the choroid, retina and iris is as variable as are the races, and the variability is increased by the number of interbreedings between races and by the influence of years of residence in northern or southern climates. These many variables may again be multiplied by the emotional characteristics of nationalities, producing a complexity of types difficult to classify.

In a broad way, however, persons may be divided according to pigment into the blond and brunette types and emotionally into three classes —the excitable, the depressed and the equable. Of course, these five groups may be further subdivided by those who are adept in coining words and adopting arithmetical tables.

To state a complicated matter simply: There are two kinds of eyes, the blue and the brown. No matter how one subdivides them into gray, green and what not, they are still essentially blue or brown. The pigment of the eye is always black. Scientifically speaking, every iris is black, but from simple observation it is known that the blue and the brown eyes do not owe their color to blue or brown pigment but that the color is merely the result of the vascularity of the iris coupled with the disposition of the black pigment.

It is known that persons of blond complexion usually have blue eyes and that dark-haired and dark-skinned persons have brown eyes. The color of the eyes usually corresponds to the color of the skin and hair.

The ophthalmologist is familiar with the disposition of the pigment in the fundus. He knows that the albino has little pigment, that persons of light complexion have a fundus reflex which is as red as the glow of the setting sun and that the Negro presents a fundus reflex that looks much like the artist's conception of a sunset seen through a wooded forest. He also recognizes that in the average fundus of the white man the pigment is not evenly distributed over the retina and there is especially a honeycombed appearance in the inferior nasal quadrant. He is likely to term this aspect stretching, because the pigment of the retina appears like smeared finger-prints. Writers of textbooks on ophthalmology even go so far as to classify the race and nationality of persons by the characteristic pigment of the fundus.

The entire subject of pigmentation of the eye has a definite relationship to the person's tolerance of light. Nature provided darker skins and eyes for persons in a tropical or subtropical climate than for

those in the northern zones. The mental concept of light, color, darkness and visual acuity itself has a definite relationship to the ocular deposit of pigment.

I mention this fact to point out the necessity of understanding the relationship of pigment in the eye to tolerance to light. With the diminution of pigment in the eye, the patient's tolerance to light is less; the annoyance from glare or excessive light is greater, and the need for supplying pigment or color in a lens is essential when the patient lacks the pigment. It is necessary to judge whether the patient has sufficient pigment in the eye for tolerance to light. The nervous mechanism connecting the eye with the brain and the sympathetic nervous system may be at fault as the result of chemical disturbances which change the conductivity of light through the insulated (medullated) and noninsulated nerves to such an extent that the mental concept of light is altered (as in migraine, hyperthyroidism, hypersuprarenalism, gonadal disturbance, high and low metabolic rates and exhaustion following severe diseases).

In such instances it is not possible to change the chemical imbalance which makes a nerve sensitive promptly enough to bring about relief. In such cases, if it were possible to add more pigment to the eye, the hypersensitivity or hyperesthesia of the nervous framework of the eye and of its centers would be reduced so as to bring about comfort. By adding pigment to the eye in the form of a tinted lens, the enhanced sensitivity of the nervous conducting mechanism is allayed. The practical application of this principle may be exemplified in acute iritis, which is attended by pain, lacrimation and sensitivity to light. The patient closes his eyes, not to reduce the pain but to reduce the annoyance of photophobia. It is not an instance of too much light caused by glare as in photophobia due to mydriasis, for in acute iritis the pupil is contracted.

Another example is photophobia in trachoma. Patients fear all kinds of light, particularly daylight. Although the pathologic condition is limited primarily to the conjunctiva and cornea, the unusual photophobia is caused not by excessive light but by the abnormal sensitivity of the light-receiving mechanism of the eye. All acute inflammations of the anterior segment of the eye are attended by true physical light allergy.

In addition to the acute inflammatory conditions of the anterior segment of the eye, there are the numerous psychogenic states, commonly classed as hysteria and neurasthenia, in which the patient complains of severe photophobia although no apparent disease of the eye exists. Such patients find comfort in the wearing of tinted lenses because they reduce the hypersensitivity of the light-conducting mechanism of the neuro-ophthalmic system.

Patients with tumor of the brain may exhibit in the early stages disturbances of light reception, followed later by complete loss of sensation in certain involved quadrants or hemispheres. On the contrary, I have never seen a patient with advanced Argyll Robertson pupils complain of such sensitivity. In fact, such patients have reduced perception of light.

Patients with unequal pupils which are inactive to light and with early stages of optic atrophy—symptoms of cerebrospinal syphilis—have defective vision which is more often than not the result of disease of the light-conducting apparatus. On contraction of the dilated pupil with physostigmine there is a tremendous improvement in vision owing to the shutting out of light from the blind parts of the peripheral field. In such instances of diminished conductivity of light tinted lenses are contraindicated.

In the chronic diseases of the posterior portion of the eye, such as tuberculosis, various forms of choroiditis, low grade papillitis, optic atrophies of all kinds, hemorrhages and exudations, intolerance to light appears only after the exudative products have been absorbed, bringing about a migration of pigment from the retina and choroid and a deposit of pigment in clumps where it is least needed and producing a moth-eaten appearance which exposes the delicate nervous elements of the retina without the protective aid of pigment. It is in the final stages of these diseases that sensitivity to light is apparent. Although vision is markedly defective, sensitivity to light is so great that early protection is needed by a uniformly tinted lens.

From a clinical and a pathologic point of view tolerance to light depends, first, on the normal and abnormal deposition of pigment in the eye and, second, on the sensitiveness of the light-receiving and light-conducting apparatus of the nervous system.

Light which is annoying to the subject depends primarily on (1) the light at its source, with its mirrored reflection on the cornea and lens, (2) the deposit of pigment in the human eye and (3) the conductivity of the neuro-ophthalmic apparatus. Alteration of any one of these three factors brings about so many variables in tolerance to light that it is impossible to classify them or to arrange them in a logical manner.

INTOLERANCE TO LIGHT IN WEARERS OF GLASSES

It is common for a person wearing glasses to experience temporary photophobia on removal of his lenses. Excepting for the blur which may be caused by the difference in visual acuity, there is undoubtedly a difference between the light to which the wearer of glasses is accustomed as it is transmitted through the lenses and the unfiltered light which enters his eye when the glasses are removed.

Ordinary white crown glass (2 mm. in thickness) absorbs from 8 to 10 per cent of light. Physicists do not state whether this absorption holds true for artificial light and the ordinary darkness of night. The eye becomes tolerant to the 90 per cent of transmitted light. Each lens has two polished surfaces, the anterior and the posterior. These surfaces are actually mirrors, reflecting during the day all objects within the range of the mirror and at night points of light from artificial sources of illumination.

Most persons read with the light coming over the left shoulder (it might as well be the right shoulder), particularly in homes in which the lamps are arranged adjacent to a comfortable chair. This custom has been adopted by reason of the accepted teaching of having the light come over the left shoulder to suit the purposes of a right-handed population. A lamp behind the reader, no matter how it is shaded, whether it is a bridge lamp, a tall floor lamp or a table lamp, will show a reflection on the posterior surface of the reader's glasses. Such a surface reflection transilluminates the wearer's glasses, producing an opalescent or fluorescent effect and a sharp ring reflection at the edge.

Light reflection of this kind causes contraction of the pupil, followed in a few moments by dilatation. The primary effect of the reflection is to improve the visual acuity of the reader. The increased acuity is due to the association of the contracted pupil with increased accommodation. This apparent increase in visual keenness is only temporary. Continued reading under the constant reflection from the posterior surface of the lens fatigues the light receptors of the eye, bringing about a diminution in visual acuity, owing primarily to fatigue of the nervous mechanism caused by intolerance.

Then again, the wearer of glasses, comfortably seated in the library or living-room reading his newspaper, book or magazine at night, is confronted by the surface reflection from the anterior segment of the lens caused by lights placed in various sections of the room. If any of the sources of light is reflected within any sector of the lens used for visual purposes, the reflection interferes with visual acuity by reason of light intolerance.

The points of light imaged on the anterior or posterior surface of the optical lens are of greater annoyance to the patient or person than the diffused glare of sunlight in midday. During the daylight hours the eyes are adapted to the intensity of light, and during the night hours the eye adapts itself to a much lower intensity of light. Relatively speaking, the eye is partly dark-adapted at night. When the dark-adapted eye is disturbed by sharp reflections on the anterior and posterior surfaces of optical lenses by points of light which are mirrored on their surfaces, a confusion of contrast results between darkness and brightness which does not exist in the daytime.

By way of an illustration, when leaving the house in the daytime and approaching the brightly sun-illuminated street, one becomes conscious of the tremendous difference in light, but when one enters from a dark room one that is illuminated by electric light the contrast is so great as to bring about a temporary photophobia. Yet the contrast at night, even with all the possible sources of illumination, is not nearly as great as that between the light indoors and that outdoors on a sunny day.

The difference lies in the sharp discrimination produced between the intense local points of illumination mirrored on the cornea of the person without glasses and the actual amount of light which enters the pupil; or in the case of the wearer of glasses the difference lies in the contrast of illumination caused by the sharp points of the mirrored images of the sources of light on the anterior and posterior surfaces of the lenses and on the anterior surface of the cornea.

The present methods of illumination by electric bulbs, principally by unshaded bulbs, is responsible for the confusion and diffusion of sharp images of light which bring about intolerance to light. It is not enough that the indoor worker or the reader under artificial light should have from 10 to 15 foot-candles of light on the reading surface. It is necessary that the light which reaches the eye be evenly distributed, similarly to sunlight, so that there are no points of reflection on the cornea or on the glasses of the wearer from the bulbs of electric lamps.

In order to overcome what is commonly called eyestrain, it is essential that the person have the proper refractive correction in his glasses and equally important that the lighting system eliminate reflection from points of light.

A more efficient system of indirect lighting should be inaugurated by the electrical companies to insure an evenness and softness of light. Until this is accomplished, I find that the greatest aid in reducing the amount of discomfort for hypersensitive eyes from light intolerance, particularly indoors at night and during the day, is the constant use of tinted lenses. My conclusion was arrived at from the results of the following series of experiments.

VISUAL TOLERANCE TO GLARE OBTAINED IN EXPERIMENTS ON STUDENTS

The objective of the experiments was to determine whether visual acuity could be improved and maintained under conditions of intolerance to light, whether glare could be tolerated over a period of five minutes and whether tinted lenses maintained visual acuity over a longer period of time than "white" lenses. The use of lenses of all tints except dark red and dark green resulted in longer preservation of vision under the

influence of glare than was possible with the white lenses. The red and green lenses reduced visual acuity to such an extent, even without the influence of glare that the results obtained from them could not be fairly compared with those from other commercial lenses.

Comparison of the acuity of different students with various tinted lenses would lead to great error, because there was no method of determining the subject's degree of tolerance to light, and, as each subject has his own normal standard, the data for each student were not comparable to those for any other. Deductions can be made only from the differences in visual acuity obtained with lenses of different color in a particular subject.

Since all subjects agreed that they experienced a greater degree of comfortable vision lasting over a longer period of time under conditions of intolerance to light with tinted lenses than with white, the logical deduction from these experiments is that the normal person under conditions of light intolerance and of glare continues his work longer with tinted lenses than with white. Since the glare in these experiments was intense and greater than that present under the ordinary lighting conditions of home and working surroundings, it is logical to conclude that the lighter tinted lenses would give proportionate results with less glare than that used in the experiments.

EXPERIMENTAL PROCEDURE [2]

Constant conditions were maintained throughout the experiment as regards the amount of light, the position of the screen, projector and subject, the order of the lenses, the order of the lighting conditions and the order of the lines.

The line was varied each minute, since the results of the readings remained practically constant if the same line was used and the subject knew what he was to see. When the line was changed each minute, although he might immediately recognize the line, he at least did not know in advance what he was to see. The lines were presented in order. The horizontal lines beginning with the top were numbered 1 to 5 and the vertical lines, from left to right, 6 to 10. There were five horizontal and five vertical lines, each containing five letters.

The Clason instrument for measuring visual acuity was used because small fractions of visual measure could be noted with it. An increase or decrease of acuity could be measured in an instant by varying the size of the test letters at will to within 0.005 of a unit of 1, the unit 1 being equivalent to 20/20 vision, Snellen scale.

Of all the means considered for measuring the increase or decrease of visual acuity effected by a glaring light, the Clason meter seemed best fitted for the experiments.

The glare was produced by exposing the eye to a 2 volt Mazda light with exposed filament such as that commonly used in an electric ophthalmoscope. Exposure was made in front of and almost touching the lens to the temporal side

2. The experimental technic was carried out by Edith Nunan, student in psychology, University of Pennsylvania.

and behind and almost touching the lens. This was done to simulate to an exaggerated degree glare from distant sources and that from reading lamps behind or to the side of the reader's face.

Six readings were taken with each lens, under three conditions of lighting: (1) with no light; (2) with a small 2 volt light (40 foot-candles at a distance

TABLE 1.—*Relation of Readings of Visual Acuity by the Clason Meter* to the Snellen Scale*

Scale Reading	Acuity, Snellen Scale	Scale Reading	Acuity, Snellen Scale	Scale Reading	Acuity, Snellen Scale
1.5	20/13	1.2	20/17	0.9	20/22
1.475	20/13.25	1.175	20/17.25	0.875	20/22.75
1.450	20/13.50	1.150	20/17.50	0.850	20/23.50
1.425	20/13.75	1.125	20/17.75	0.825	20/24.25
1.4	20/14	1.1	20/18	0.8	20/25
1.375	20/14.25	1.075	20/18.5	0.775	20/26
1.350	20/14.50	1.050	20/19	0.750	20/27
1.325	20/14.75	1.025	20/19.5	0.725	20/28
1.3	20/15	1.0	20/20	0.7	20/29
1.275	20/15.5	0.975	20/20.5		
1.250	20/16	0.950	20/21		
1.225	20/16.5	0.925	20/21.5		

* Letters, size no. 1, by the Clason system.

TABLE 2.—*Lines Projected by the Clason Instrument and Read with the Lenses Indicated**

Line 1: C N D B R
Line 2: E O T S L
Line 3: F R C E H
Line 4: V P S R K
Line 5: L T U V B

Line 6	Line 7	Line 8	Line 9	Line 10
L	T	U	V	B
V	P	S	R	K
F	R	C	E	H
E	O	T	S	L
C	N	D	B	R

Line	1	2	3	4	5
	Plain	Softlite 1	Softlite 2	Softlite 3	Softlite 4
	Smoke 1	Smoke 2	Smoke 3	Smoke 4	Fieuzal 1
	Crookes 1	Crookes 2	Crookes 3	Crookes 4	Amber 1
Line	6	7	8	9	10
	Red A	Green A	Cruxite A	Cruxite B	Cruxite C
	Fieuzal 2	Fieuzal 3	Azurlite 1	Azurlite 2	Azurlite 3
	Amber 2	Amber 3	Dualens, light shade	Antiglare	Dualens, sport-shade
	Kalichrome A	Kalichrome C			

* Reading of letters of size no. 1 on scale is equivalent to vision of 20/20 by the Snellen scale.

of 1 inch [2.54 cm.]) in front of the lens; (3) with the light 40 foot-candles at a distance of 1 inch in back of the lens.

The readings were taken in such a way that the subject read the line that he did at the beginning five minutes later and read the same lines for each lens under all three conditions of lighting, so that the variable factor was the lighting condition of the lens. For example, the readings with the plain lens always began

with line 1, went on through lines 2, 3, 4 and 5 and after five minutes were again based on line 1. After the readings with the series of lenses were completed under that lighting condition, I began with the new condition, that is, with the light in front of the lens, again beginning with line 1. Readings with the tinted lens 1 started with line 2 under each of the lighting conditions. All the subjects had the same line to read at the same time with each lens.

The reading taken was the highest point on the scale at which the subject could read all the letters (not that at which he could recognize the pattern, as he soon learned to do). One had to depend on the subject's integrity in this respect. I think that all the subjects were truthful, for although they may have known the pattern they read only the letters they saw and then waited till I moved down on the scale to a point at which they could actually read all the letters.

After each five minute period, the subject had at least one and one-half minutes of rest, or longer if he cared for it. After the five minute periods of readings were completed for the series of lenses under one lighting condition, the subject took a rest of at least five minutes. The subject was never forced to go on until he wanted to. By the periods of rest, I consider that the factor of physical or mental fatigue was greatly eliminated.

The subject used one eye throughout the entire experiment, the one he preferred.

OBSERVATIONS

I believe that the factor of physical or mental fatigue has been eliminated so far as was possible, because no subject was ever urged to go on with the experiment until he was ready. On the contrary, the subjects often asked to eliminate the periods of rest, saying that they felt no fatigue from the experiment. Also, the readings at the end of the day's experiment were superior to those at the beginning, which seems to show that physical or mental fatigue did not enter into the experiment.

Although the light was considered an annoyance, in most of the readings taken with the light, held either in front of or back of the lens the readings were superior to those without the light. This statement is borne out even by a cursory glance at the experimental results. All the subjects agreed that the light when held in front of the lens clarified or made the image brighter than it had been without the light.

Although at first some of the subjects remarked of certain lenses, "My, this feels good," at the end of the trials with the series of lenses they expressed no definite preference, or if they did it was with such a small degree of assurance that it would not constitute a real preference.

An examination of the chart showing the best lens for each subject both at the beginning and at the end of the five minute period reveals several things. First of all, Softlite, smoke and Crookes lenses predominated. That these three series were used first in the experiment brings out an important point—that learning was largely eliminated as a factor in the experiment, which is what was hoped for. There was a decided lack of visual acuity with the lenses which were used

during the last three sessions. Had these lenses appeared to give a higher visual acuity, the criticism that learning rather than visual acuity was involved might well have been advanced.

In five of the eighteen possible times the lens which was best at the beginning was still best at the end of the five minute period. That a high reading was obtained at first also explains rather sudden or large decreases in visual acuity with some of the lenses. This decrease, then, does not indicate that the lens did not hold up as well as the others

TABLE 3.—*Lens Giving Highest Visual Acuity for Each Subject Under All Three Conditions of Lighting* *

Name	Best Lens at Beginning of Five Minutes	Best Lens at End of Five Minutes
Mr. S. I.	a. Crookes 2	a. Fieuzal 3, Amber 3
	b. Cruxite A†	b. Cruxite A, Kalichrome C
	c. Kalichrome C	c. Kalichrome A
Miss F. M.	a. Smoke, Crookes 3	a. Crookes 1, Crookes 3
	b. Smoke 1	b. Crookes 2 and 3, Smoke 3
	c. Smoke 2	c. Crookes 1
Miss E. D.	a. Amber 3	a. Amber 1, Azurlite 1
	b. Cruxite B	b. Cruxite C
	c. Smoke 1	c. Dualens (light)
Miss V. S.	a. Smoke 1 and 4, Antiglare	a. Smoke 3
	b. Smoke 3	b. Smoke 4
	c. Smoke 1, Smoke 2	c. Smoke 2
Mr. C. H.	a. Softlite 1 and 2	a. Softlite 2
	b. Softlite 3	b. Softlite 2
	c. Softlite 2 and 3, Smoke 3	c. Softlite 1 and 2
Miss M. M.	a. Softlite 3 and 4	a. Softlite 4
	b. Softlite 2	b. Softlite 4
	c. Softlite 4, Smoke 1	c. Softlite 1

* a represents five minute period with no extra light; b, period with light in front of the lens, and c, period with the light back of the lens.

† The lenses underlined are those which were best for the subject both at the beginning and at the end of the five minute period.

—that it did not assist preservation of vision. In some cases the final reading of the five minute period with these lenses was still superior to that with lenses which showed little loss in visual acuity.

An examination of the chart [2a] showing the change in the visual acuity with the use of each lens for each subject indicates, first, that on the whole the losses or gains in visual acuity are but a small fraction of normal vision and, second, that amber and cruxite lenses do not improve or diminish visual acuity under the stress of glare. Although plain lenses were used for each subject, in practically no case did they give the highest visual acuity.

2a. The chart is omitted for reasons of space; conclusions only are published.

ALL TINTED LENSES HAVE MERIT

The following deductions from the experiments may be made:

Practically all the tinted lenses on the market are of value. Their value may be estimated primarily on the ability to cut down uniformly the various wavelengths of the spectrum, ordinary daylight and artificial light and at the same time diminish the reflection of points of light falling on the anterior and posterior surface of the lens and on the anterior surface of the cornea.

I conclude that the reflection on the surface of the lens plays an important part in the intolerance to light both in the daytime and at

Photographer caught by his own camera, illustrating surface reflection of lenses. Photographed by the Carpenter-Greenland 1934 Expedition for the Academy of Natural Sciences of Philadelphia.

night. One can readily demonstrate this by focusing a beam of light with the slit lamp across the cornea, a demonstration known as the sunset illumination, which causes the cornea to fluoresce completely. If the patient is asked to look at an object while the beam is so transfixed through the cornea, it is impossible for him to see it. A simpler illustration is to place a photograph under the plate glass top of a desk. If a desk lamp is placed overhead or near-by in such a position that the mirrored effect of the lamp is seen on the glass directly over the photograph, it is impossible for the observer to see the photograph at the point at which the mirrored surface of the lamp is seen on the plate glass (figure).

This is exactly what happens when a person reads in the library at night with the desk lamp over his left or right shoulder. The mirrored

effect of the images of the lamp on the posterior surfaces of the glasses renders vision difficult until the reader changes the position of his head. Other lamps in the room mirrored on the anterior surfaces cause a similar intolerance to glare unless the head of the reader is adjusted to avoid the glare. It is impossible to avoid it completely, because in a room with subdued lighting by lamp there is a point of reflection on the lenses from every source of illumination in the room. A tinted lens reduces the reflection to a point of tolerance.

In my experiments I noted the retention of visual acuity over a longer period of time with tinted lenses than with colorless.

Although some of the tinted lenses gave better results for one subject than for others, it should be remembered that the persons used in these experiments were apparently normal in visual function. There is no such thing as a normal standard of fatigability from light any more than there is a normal standard of physical and physiologic development. There are so many varieties of the normal that it is impossible to adopt a figure or quantity which applies to all normal persons.

FATIGABILITY AND SENSITIVITY TO LIGHT

Wentworth [3] found that the chromatic and the achromatic response of the human retina from the macula to the periphery vary within great extremes in the same person when tested under different conditions and sometimes under similar conditions at different times of the day, so that a test which concerns the fatigability of the eye under the influence of glaring and of reflected light would result in as many variables. By fatigability, Wentworth, no doubt, meant intolerance to light.

In this connection, Luckiesh [4] may be quoted: "The determination of the best conditions for the human seeing-machine requires the development of new methods and technique and the measurement of psycho-physiological effects, such as fatigue, nervous tension, muscular strain and other complex effects." I am tempted to add to Luckiesh's measurements those still newer—physical allergy to light and tolerance to light.

Wentworth stated: "Not only is the eye a different organ under light and dark adaptation, but the process of adaptation is in itself one of the most delicate of optical functions and one liable to early and important changes as a result of pathology."

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3. Wentworth, Hazel Austin: Quantitative Study of Achromatic and Chromatic Sensitivity from Center to Periphery of Visual Field, Psychol. Monog. **40**:1, 1930.

4. Luckiesh, Matthew: Seeing and Human Welfare, Baltimore, Williams & Wilkins Company, 1934, p. 32.

Here again, Wentworth might aptly add that a pathologic condition not only of the eye but of the general nervous system and an altered response of the nervous system to light tolerance are factors of importance.

Spaeth [5] called attention to the fact that the fovea is most sensitive in the light-adapted eye and least sensitive in the dark-adapted eye. The paracentral region is a thousand times more sensitive under these circumstances than the fovea itself. Here again, sensitivity may be interpreted as tolerance to light.

This statement, added to many others concerning the variability of the eye under different conditions, makes it even more apparent that psychophysiologic tests have an important part in arriving at the patient's normal tolerance to light.

In the efforts of physicists to delve deeper into the question of the achromatic and chromatic sensitivity of the various portions of the eye, the part which the sympathetic nervous system and the psychic state have in these tests must not be forgotten.

The use of coined, high-sounding words and phrases which require digestion makes the problem of vision a complicated one. There are, however, simple factors and fundamental facts which may be understood by every one as he reads.

Ocular comfort, whether it is psychic, physical or physiologic, is understood by the patient only in terms of results.

Thousands of persons wear tinted lenses with comfort. It is well to have the explanation from a scientific angle. It is said that the periphery of the eye is dark-adapted and, therefore, reacts unfavorably to glare caused by indirect reflection from the surface of pavements, from the marginal reflection of eye-glasses and from internal reflection produced by the lens and the media of the eye. The patient himself recognizes the effect of indirect glare. It requires no scientific test to prove it. He complains of burning of the eyes and fatigue after reading for a time under an electric light, and he finds that the fatigue is allayed or diminished considerably by the aid of tinted lenses. The therapeutic test is often the only scientific proof.

GLARE AND VISION

"Glare may be defined as any brightness within the field of vision of such a character as to cause discomfort, annoyance, interference with vision, or eye fatigue." This is the definition described in the Code of Lighting, prepared under the direction of, and published by, the Illuminating Engineering Society and approved on Aug. 18, 1930, by the American Standards Association.

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5. Spaeth, Edmund B.: Clinical Determination of the Light Threshold, Arch. Ophth. **2**:462 (March) 1934.

Many other definitions have been noted in the literature; in short, glare is spoken of as unwanted light. The test of glare, according to physicists, is subjective, each person deciding for himself what is comfortable or uncomfortable. For instance, I can sit on the beach at the seashore without much discomfort from the glare of the sun. Thousands, however, prefer the comfort of tinted lenses of all colors and shades, varying from light amber to blue, green and black. Purchasers select the color and density of the lenses by mere guess or by "taste" in color, and yet all of them derive comfort from avoidance of the annoying glare from the water and sun.

I wish to comment on the statement of Luckiesh that glare "causes eye strain disorders. The pupil tends to close and causes strain upon the muscles controlling it." The words "strain" and "eyestrain" are the most abused words used in studies of light and vision.

Luckiesh continued: "A glaring source in the visual field, but not in the line of vision, has its image focused on the retina. This reduces the sensitivity of the retina and also visibility." This statement is readily refuted. There is no proof that the image of the source of glare is focused on the retina when not in the line of vision or that it reduces the sensitivity of the retina, but there is ample clinical proof that it reduces visibility. Intolerance to light and physical allergy to light explain the reduction of visibility by the physiologic interruption of visual reception.

The general impression prevails that eyestrain is muscular fatigue caused by excessive work and that there is an interrelationship between light in contact with the retina and the muscles of the iris which control the contraction and dilatation of the pupil. This is readily disproved. Atropine produces dilatation of the pupil and renders inactive the muscles which control it and accommodation. Light enters the atropinized eye and causes discomfort without the interaction of the muscles of the eye.

The eye cannot tolerate the excessive light which enters it. Neither the muscles of the iris nor the nervous mechanism which actually controls the size of the pupil plays a part in the glare or in the intolerance to light caused by the use of mydriatics. The muscular effort of the iris (involuntary) is no more subject to fatigue from light than are the muscles of the middle ear (tensor tympani and stapedius) to sound. The muscles of the iris are intended to control the entrance of light, and the muscles of the middle ear that of sound. The ophthalmologist regards the ciliary muscle controlling accommodation as the one responsible for eyestrain coincident with visual effort.

On the other hand, chronic or subacute glaucoma is treated by physostigmine or other miotics, bringing about the constant and repeated contraction of the pupil. If the continued contraction of the pupil caused by excessive light brings about fatigue of the muscles of the eye,

as the physicists state, the constant contraction from the use of miotics should also produce "eyestrain."

The point that I wish to make is that the involuntary muscles of the eye, that is, those concerned with the sympathetic and parasympathetic nervous systems, are not fatigued in the same sense as the voluntary muscles of the body. The fatigability of the eye is primarily neurologic, caused by intolerance to light.

A patient with amblyopia exanopsia, possessing very low vision, does not complain of eye fatigue or aching of the eyes because of his poor vision, although the pupillary reactions to light are prompt, nor does he complain of glare from ordinary light, because the impression of the intensity of light is not distinguished by the centers in the brain; he has a high tolerance to light.

On the other hand, the person with very high myopia has extensive destruction of the retina, but his sensitivity to light is many times greater than that of the person with a normal eye. In the person with high myopia there is almost complete atrophy of the ciliary muscles of accommodation and the muscles which control the size of the pupil. Glare does not cause fatigue of the involuntary ocular muscles in such a person. It is nothing more than neurologic sensitivity to the amount of light which ordinarily is readily tolerated by the normal eye. It is light allergy. It is synonymous clinically with the photophobia which the ophthalmologist sees in all inflammatory conditions and in the defense mechanism commonly called blepharospasm.

An attempt to treat glare by the physicodynamic principles, by aiming to control the size of the pupil, is not wholly correct. The fundamental principle in the control of glare should be the patient's neuro-ophthalmic tolerance to light. Heretofore, it has been said that much depends on the special absorptive quality of the lenses used. It is my contention that all lenses capable of reducing the sensitivity of the cerebroretinal mechanism for light are valuable in the control of the common symptom, sensitivity to glare. Such a lens must transmit sufficient light, undisturbed by surface reflections from the lens itself, with such a physiologic effect (for want of a better phrase) as to give the patient a sense of softness as compared to that of harshness. It is difficult to describe in words the mental impressions. Light of excessive character, of high or even of low intensity, produces unpleasant sensations which divert attention and disturb the act of seeing.

The normal eye finds no discomfort in the many ranges of light under which the person is required to work. Just as a sensitivity to hay fever and asthma may develop in early childhood, so may a sensitivity to light.

Persons with refractive errors may get along well with their reserve muscle force, with the involuntary muscles of the eye to overcome

the defect. When the patient shows sensitivity to ordinary light, the refractive error becomes more manifest. All wearers of glasses have the advantage of an absorption of approximately 8 per cent of the rays of light which pass through the lenses.

The refractionist has heretofore failed to give credit to this particular quality of absorption of crown glass in the relief of refractive errors, which, as he conscientiously believed, produced all the neurologic symptoms of which the patient complained. This absorption also accounts for the explanation offered by the renowned Weir Mitchell, who pointed out the relationship of neurologic conditions to small refractive errors. It is my contention that, in reality, the small refractive error, especially astigmatism, which is found in almost every eye, is not the whole basis for neurologic symptoms but rather light sensitivity which becomes automatically reduced by the wearing of white glasses.

TRANSMISSIVE PROPERTIES OF TINTED LENSES IN RELATION TO LIGHT TOLERANCE

The most authoritative work on the transmissive properties of tinted lenses in the American literature is that by W. W. Coblentz,[6] to whom the medical profession owes a great debt for the thorough and comprehensive analysis of the physical properties of the various types of tinted lenses in which the ophthalmologist is interested. It is my opinion that at the present time there is no other physical means of designating tinted lenses than by their absorptive or transmissive properties. It would appear that optical glass should transmit such properties of the visual spectrum as will insure clarity of vision and enable the wearer to distinguish contrasts in color. It does not immediately follow that 100 per cent of the visible spectrum shall be transmitted in all its wavelengths through optical glass. One adapts oneself to the visual acuity on cloudy, rainy, snowy and sunny days and to the light at night. The eye, being readily adaptable to changes in light, may conveniently be comfortable with light that is transmitted through crown glass.

According to Coblentz clear optical glass transmits from 89 to 91 per cent, the rest being lost by reflection. Wearers of glasses do not object to this loss of light in its transmission through ordinary clear lenses. Coblentz further stated, as have other authorities, that smoked glasses have a fairly uniform absorption throughout the visible spectrum. They are further said to have a neutral tint. If smoked glass A absorbs from 10 to 20 per cent of the visible spectrum and smoked glass D from 80 to 90 per cent, it does not follow that the greater the absorptive

6. Coblentz, W. W.: Transmissive Properties of Tinted Lenses, Am. J. Ophth. **15**:932 (Oct.) 1932.

quality of a lens the greater is its ability to reduce the glare in intolerance to light. If this were true, glare and light would be synonymous.

Coblentz contended that tinted lenses which transmit from 80 to 88 per cent of the visible spectrum have no greater qualities in the reduction of glare than has clear glass which absorbs from 80 to 91 per cent. He failed to take into consideration that the glare itself has a distinct psychophysiologic effect on the light-conducting apparatus. It is only necessary to reduce glare from a degree of intolerance to one of tolerance. I, therefore, take it that the absorptive property of a lens is not in itself an accurate designation of its glare-reducing property.

In practice, it is desirable to reduce glare and annoying reflection both in the daytime and at night, to maintain excellent visual acuity and to prescribe such lenses as are not objectionable in color. Smoked lenses are generally objectionable for constant wear because they are black. They are depressing, primarily because of their color. Women particularly would rather suffer discomfort of the eyes than submit to their use. When mydriasis is used for refraction and black glasses are placed on the face, I have seen women remove them and walk out of the office, despite the warning of the effect of sunlight on the eyes with dilated pupils. Scientifically, smoked glass A should be ideal for glare-reducing purposes, but the chief drawback of its use in practice is the color and the fact that it transmits only 70 per cent of blue, 69.7 per cent of green and 73.1 per cent of red rays.

The Crookes A lens is a good glass for constant use because of its absorptive quality, but its scientific defect lies in its unequal absorption, especially in the yellow part of the spectrum. The dark color is objectionable from the patients' point of view giving the eyes a dark gray appearance and the skin of the lids a slate-colored aspect.

Azurlite lenses 1 and 2 are uniformly absorptive and reduce surface reflection as do the lenses of other tints. The color again is not psychologically correct for the woman or man who objects to its depressing color, except in the darker shades for outdoor sports.

Kalichrome A appears to absorb less than crown glass, whereas Kalichrome C cuts out much of the blue rays. Amber glass is not ideal for constant use because it absorbs too much of the violet, blue and green rays. Fieuzal also absorbs too much of the violet, blue and red for constant use. Cruxite AX and Softlite 1 are much alike in color and appear to have the rose tint most popular from the wearer's standpoint. They are inconspicuous, pleasing and acceptable to the most discriminating patients.

Since the eye and the entire human mechanism are affected by psychic influences, color must play a part in the mechanics of sight. Some colors are more pleasing than others. The rose color of cruxite AX and Softlite 1 have a definite sedative effect on light allergy and

light intolerance. Clinical evidence is the only proof offered and the only one available. Possibly the psychologist has a theoretical explanation. Peculiarly enough, all the students tested with tinted lenses claimed that the lighter tints of the commonly prescribed glasses have a restful effect on the act of seeing and that the normal 20/20 line of the Snellen scale seemed steadier and easier to discern. Preference, however, was given to the lenses having a rose tint.

TABLE 4.—*Transmission of Light of Different Wavelengths in the Visible Spectrum by Spectacle Lenses of Colored Glass (from Redway*[7])

No.	Lens	Color	Transmission in per Cent			
			Blue	Green	Red	White
1	Spectacle	White	93.50	94.00	87.00	93.72
2	Softlite	Lightshade	93.50	81.00	87.00	93.62
3	Amethyst	Number 1	85.00	87.00	79.10	86.99
4	Plate glass	White	86.50	87.00	94.00	86.78
5	Crookes	Number 1	93.11	80.54	96.00	86.30
6	Blue	"A"	99.54	81.10	86.50	86.25
7	Amethyst	Number 2	76.00	80.00	92.50	82.91
8	Softlite	Darkshade	89.00	75.50	86.90	81.16
9	Noviol	"B"	9.78	72.00	90.00	81.00
10	Hallauer	Number 62	10.56	87.50	66.00	80.78
11	Noviol	"C"	11.35	90.00	85.00	76.00
12	Amber	Number 1	69.00	82.00	80.50	75.20
13	Softlite	Sportshade	66.00	72.50	75.50	75.15
14	Fieuzal	"A"	59.57	80.13	80.36	73.29
15	Smoke	"A"	70.00	69.70	73.10	70.28
16	Amethyst	Number 3	65.00	69.75	69.10	69.90
17	Amber	Number 2	50.10	65.20	70.50	69.80
18	Uviol	Yellow	28.71	64.57	86.30	69.67
19	Amethyst	Number 4	60.20	60.80	75.30	65.30
20	Blue	"B"	75.69	69.67	60.40	65.17
21	Crookes	Number 2	75.34	74.82	80.73	65.02
22	Fieuzal	"B"	55.59	69.67	74.99	65.02
23	Amber	Number 3	40.50	54.20	69.20	61.60
24	Fieuzal	"C"	40.46	64.72	55.59	59.85
25	Smoke	"B"	52.00	51.50	55.00	52.06
26	Amber	Number 4	18.00	47.10	44.00	51.53
27	Crookes	Number 3	55.85	47.65	55.85	50.59
28	Hallauer	Number 63	15.70	37.50	40.28	40.37
29	Smoke	"C"	34.00	34.00	37.20	34.11
30	Blue	"C"	55.50	31.50	21.73	28.58
31	Amber	Number 5	11.50	21.20	29.80	24.10
32	Blue	"D"	40.94	19.68	12.39	15.82

Objection has been raised by many ophthalmologists that the tint needed in daylight is not necessary for use at night. In order to overcome this objection, I suggest the use of a glass which is clear in the center and tinted at the periphery. Such a glass would be ideal for peripheral light reflected from surfaces below and would lessen the marginal reflection of eye-glasses and the fluorescence of lenses in artificial light. Such a glass can be made by fusing a tinted glass and a clear crown and by grinding the center of the tinted surface until the clear glass alone is seen. I am of the opinion that such a glass would be excellent for the myope and for all others sensitive or intolerant to artificial indoor lighting.

In determining the values of tinted lenses, much stress has been placed by manufacturers on their transmission in the various spectral divisions. From the standpoint of the ophthalmologist, it is essential that tinted lenses for constant use have a large transmission of white light. In this respect I include table 4 taken from Redway's [7] study.

If more light is needed for purposes of seeing (not visual acuity), as Luckiesh claimed, the tinted lenses having the greatest transmission of white light, sufficient tint for changing intolerance of light to tolerance and the most pleasing psychophysiologic effect are preferable.

PSYCHOLOGY OF COLOR IN RELATION TO LIGHT ALLERGY

There is no doubt that color plays a part in the emotional make-up. Sunshine is exhilarating, while rain is depressing. It is the psychic influence of the freshness of color in daylight illuminated by sunshine, compared with the depressing effect of overhanging clouds and the dreariness of rain. Paintings impart to one something pleasing or displeasing. The interior decorations of a room or of a hotel lobby are inviting or uninviting, depending on color arrangement. Hospital rooms are painted in colors which are pleasant and cheerful instead of in the drab, dreary and cold effect of contrasting color. From a psychologic standpoint there is a color preference even in the choice of glasses.

According to Staples,[8] infants perceive color at the age of 3 months. Color preferences are evidenced between 6 and 15 months of age in the following order: red, yellow, blue and green. Staples studied color preference in 262 infants ranging in age from 69 days to 24 months. The children of 3 months of age showed no preference. Four colors were distinguished at the age of from 12 to 15 months and recognized as distinctly different sensations. Yet from the age of 6 to 24 months there was an unequal response to different colors.

Walton [9] studied color preferences in 1,279 students at the University of Nebraska for a period of fourteen years. The men showed a preference for orange over yellow and the women for yellow over orange. Preference for red fell between the years 1910 and 1918 and is now ascending. Women's preferences fluctuated more than men's.

Persistent differences in effective values for colors, in spite of fluctuations from year to year and in spite of sex differences indicate that, in addition to social conditioning and other environmental factors, there are undoubtedly deep underlying biological factors that help to determine color preferences.

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7. Redway, Laurance D.: Am. J. Ophth. **11**:974, 1928.

8. Staples, Ruth: J. Exper. Psychol. **14**:119 (April) 1932.

9. Walton, W. E.; Guilford, Ruth B., and Guilford, J. P.: Am. J. Psychol. **45**:322, 1933.

The most distinct preference for color was that for red in both men and women in 1910-1911; it declined until 1917-1918, when it reached a minimum value; since then it has increased to the present time. The results may be stated as follows:

Eight hundred and fifteen women for the years from 1910 to 1931 showed preference for colors in the following order: red, blue, green, yellow and orange. Four hundred and sixty-four men for the same period showed preference for the colors in the following order: blue, red, green, orange and yellow.

A study by Walton [10] of the effective values of colored lights among 180 men and 163 women gave the following results:

Men	Women	Combined
Blue	Green	Blue
Red	Red	Green
Green	Blue	Red
Amber	Amber	Amber
Clear	Clear	Clear

Twitmyer and Nathanson [11] regarded the human being as a "soundboard" and deduced therefrom that an existing defect reflects itself in changed behavior.

If the human being is a "soundboard," he cannot be considered such without consideration of the influence of light. Certainly, colored lights also reflect themselves in changed behavior; or I might state it otherwise by saying that physical light allergy has its effect on the psychologic make-up of the person. There is undoubtedly a neurophysiologic factor which is influenced by light in its various component parts as perceived by the eye. Call it nervousness, neurasthenia, psychogenic state or what not, there is undoubtedly an unfavorable reception of certain colors by the light-receiving mechanism of the nervous system. The psychologist may term this condition an altered state of the human mind, but I explain the phenomenon on the ground of physical light allergy. Just as the skin is sensitive to light and to its various components, whether visible or invisible, most assuredly the neuro-epithelium of the retina and its connecting links with the entire nervous system may under like conditions repel unwanted light and make the repulsion evident in a way that is broadly termed eyestrain. Tinted lenses of a color pleasing to the eyes and having uniform transmission of all visible wavelengths which reduce intolerance to tolerance and subdue actual physical light allergy supply the remedy.

10. Walton, W. E., and Morrison, Beulah M.: J. Applied Psychol. **15**:294, 1931.

11. Twitmyer, E. B., and Nathanson, Yale: Auditory Perceptibility, Acuity and Dominance, Psychol. Clinic **32**:229, 1933-1934.

CONCLUSIONS

1. Tinted lenses have a definite place in ophthalmic therapeutics.

2. Their clinical selection should be based on the ability to reduce intolerance and abate light allergy, maintaining a maximum visual acuity.

3. They should for practical purposes transmit uniformly the wavelengths of the visible spectrum.

PRESENT STATE OF THE OPERATIVE TREATMENT FOR DETACHMENT OF THE RETINA IN EUROPE

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The operative treatment for retinal detachment has gone through several phases, and a method has now been arrived at which is being quite uniformly used. The ignipuncture of Gonin and the potassium hydroxide method of Guist have practically been given up; electrocoagulation is the present method of choice. Electrocoagulation produces an adhesive choroiditis which binds the retina and the choroid together and thus closes off the pathologic focus, whether it is a hole, a rupture, a disinsertion or an area of degenerative changes in the retina. Apparently large areas may be coagulated without damaging the integrity of the eyeball.

The success of the operative treatment has led to the study and investigation of detachment of the retina in all its phases, so that the knowledge concerning the clinical aspects has been greatly increased; perhaps the greatest advance is the recognition of the frequent presence of a hole in the retina and in the fact that this hole has to be closed off to effect a cure. The necessity for accurate localization of the hole has become less exacting, as a larger area can be treated by the method of electrocoagulation, and the pathologic focus can be more easily included.

In Europe electrocoagulation is applied in two ways: surface coagulation and penetrating coagulation. The preliminary exposure of the operative field is the same in both methods. One operator (Meesmann) uses N-methyl-cyclo-hemenyl-methyl-barbituric acid to avoid postoperative vomiting and to keep the cornea clear during the operation; all other operators use local anesthesia. Some resect one of the rectus muscles if necessary; others prefer to leave them alone and to retract them away from the operative field. The localization is generally done by the method originally laid down by Gonin. Weve is the only one who follows a special method of localization with his substitution perimeter. In any case the localization must be done carefully; Arruga says that the success of the treatment consists in exact localization and that this requires much patience in the dark room. In some instances the hole is again localized when the sclera over the affected retina is exposed at the time of operation by throwing in the light of an ophthalmoscope with either direct or indirect illumination (Lindner and

Weve) and marking the position of the light beam on the scleral surface with india ink or gentian violet; the limitations of this procedure are apparent. Some operators have objected to a preliminary puncture to serve as an ophthalmoscopic guide because the resulting softening of the eyeball makes further penetration of the sclera difficult and may lead to the formation of an albuminous effusion into the vitreous (Weve). To keep the cornea clear for ophthalmoscopic examination during the operation, Weve applies a contact glass to the cornea and Vogt suggests that the contact glass be sutured in place.

Whether the coagulation is superficial or penetrating, the common guiding principle is to shut off the pathologic focus and then, if possible, to surround it by an additional delimiting curved line of coagulation extending from ora to ora.

Surface coagulation is practiced by applying a ball electrode (Weve and Larsson), a disk electrode (Coppez) or a thick, blunt wire electrode (Meesmann) to the sclera over the affected retinal area. This is applied as many times (Weve) as are necessary to produce a grayish effusion in the affected retinal area as seen with the ophthalmoscope, the color of the sclera in the meantime having changed to a brownish gray. Then one or two punctures are made with a sharp probe (Larsson) with a knife needle (Coppez) or with a fine electrode (Weve) at the most dependent part of the coagulated area for drainage; some operators precede this puncture by making a trephine opening.

The perforating method consists in making numerous punctures with a single or a triple electrode penetrating from 0.5 to 1.25 mm. deep (Šafář, Lindner, Arruga, Meesmann and Clausen). These punctures are applied in the scleral area over the affected retina, according to the principle outlined. Finally, a larger electrode is used (Meesmann) in the dependent part to obtain a broader opening for drainage. In the areas which are not readily accessible, such as those situated in the posterior half of the eyeball, the brush electrode on a curved stalk (Šafář) is generally used. The stick pins, single or triple, of Šafář are used by several operators to avoid premature escape of the subretinal fluid with resulting softening of the eyeball, which makes further penetration difficult and dangerous.

An interesting modification of electrocoagulation has been suggested by Coppez and Meesmann. On the basis of the theory that the diathermic scar depends on the temperature to which the tissue is raised during coagulation, measurement of the temperature should furnish an objective control of the desired result and should be more accurate than any measure of the current employed; furthermore, the effect should always be the same if the same degree of heat is obtained. This is accomplished by a pyrometric electrode made of two metals of different

electrical resistance, copper and constantan, in which the electrode acts as a thermometer and the degree of heat obtained in the tissues can be read on a galvanometer. A full description is given in the article by Coppez.[1]

Coppez places a flat electrode (a disk 2.5 mm. in diameter) on the sclera a number of times according to the guiding principle previously mentioned. Each application remains in place until a temperature of 80 C. is reached on the galvanometer. This must not be obtained quickly but should require twenty seconds; Coppez calls this slow coagulation, on which he is very insistent. The desirable length of time of application and the degree of heat developed have been arrived at by experiments on animals' eyes. Coppez rejects any perforating procedure, as in his opinion it produces fulguration and not coagulation and consequently is likely to injure the retina and the vitreous. At the conclusion of his operation, Coppez makes an incision with the knife needle at two of the most dependent coagulated spots for drainage. Meesmann uses a fine pointed pyrometric electrode. This type consists of two wires, copper and constantan, enveloped in a curved quartz glass tube with a point of varying thickness, so that the depth of penetration and the size of the perforation can be altered at will. The electrode is introduced into the sclera as is the ordinary needle electrode, to the depth of 0.5 mm., and is left in place for from six to eight seconds until the desired degree of temperature of from 65 to 75 C. is reached. Meesmann uses three electrodes: a fine one for perforation, a medium one for drainage and a blunt one for surface coagulation. The effect is observed by repeated examinations with the ophthalmoscope. Drainage is obtained in the dependent parts by one or two perforations with a broader needle, which Meesmann prefers to trephining with its possible disadvantages.

Finally, Vogt has just published another, and a very simple, operation which consists in the ordinary electrolysis method. A fine needle is repeatedly introduced which punctures the retina at the margin and in the depth of the hole; the bubble of hydrogen which arises can easily be seen with the ophthalmoscope and serves as a guide. Vogt says that this is the safest and simplest method and will replace all others.

Holes in the macula have been successfully treated by the undermining procedure of Lindner. This consists in making a trephine opening well back from the limbus, then creating a subchoroidal tract as in cyclodialysis and injecting 1 minim (0.06 cc.) of a 3 per cent solution of potassium hydroxide with a curved cannula in the area to be treated.

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1. Coppez, L.: Le traitement du décollement de la rétine par la diathermocoagulation pyrometrique, Arch. internat. de méd. expér. **9**:177 (July) 1934.

SUMMARY

Operators abroad, as far as I can judge, are abandoning deep penetration of the sclera and are attempting to obtain the coagulation effect in the choroid by methods applied to the surface or to the interstices of the sclera and by superficial perforating coagulation.

It is agreed that neither the retina nor the vitreous should be damaged. The necessity for a thorough evacuation of the subretinal fluid is generally accepted as essential for obtaining a healing of the detachment, and to assure this evacuation drainage for some time after operation is desirable. Arruga insists that the retina and the choroid be in contact at the conclusion of the operation; then recovery is probable. Lindner speaks of the importance of a supraretinal fistula, and Šafář is of the opinion that one of the advantages of his triple stick electrodes is drainage.

I think that both surface and penetrating coagulation should be used according to the conditions present in each case. The important aim in this operation, as in all operative procedures, is to reduce traumatism. This should follow greater experience and better technic. The ideal result of coagulation is an area of depigmentation with some pigment proliferation but without exudation. To obtain this the spark gap in the high frequency machine should be readily adjustable so as to regulate the cutting and coagulating components according to the individual case.

THE FILTRABILITY OF TRACHOMA VIRUS

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In previous reports [1] evidence was presented which indicated that trachoma is not a bacterial disease and which suggested that a filtrable virus is the etiologic agent. The nature of the Halberstaedter-Prowazek inclusion bodies,[2] found in epithelial scrapings from patients with trachoma, was discussed in a recent report; [1c] on the basis of microscopic evidence, the conclusion was supported that the inclusion bodies of trachoma were intracellular colonies of a virus which might be the etiologic agent of the disease. The virus was found to be identical morphologically with the virus of inclusion blennorrhea [3] and strikingly similar to the virus of psittacosis.[4] Like these viruses it occurred in two phases: the large, initial body (Lindner) phase and the small, elementary body phase. By analogy it seemed logical to suppose that the elementary body phase would be the filtrable one. Experiments with suspensions of elementary bodies showed that the elementary bodies were adsorbed by the pore walls of the usual kieselguhr and porcelain filters and were thus removed completely from suspension. When graded collodion filters with small filtration areas were employed, however, it was possible to obtain bacteria-free filtrates containing elementary bodies. On the basis of these experiments it was suggested that

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1. Thygeson, P.: (*a*) Rôle of Bacterium Granulosis in Trachoma, Arch. Ophth. **10**:1 (July) 1933; (*b*) Recherches expérimentales sur le trachome, Arch. Inst. Pasteur de Tunis **22**:157 (Aug.) 1933; (*c*) The Nature of the Elementary and Initial Bodies of Trachoma, Arch. Ophth. **12**:307 (Sept.) 1934.

2. Halberstaedter, L., and von Prowazek, S.: Zur Aetiologie des Trachoms, Deutsche med. Wchnschr. **33**:1285, 1907.

3. Thygeson, P.: Etiology of Inclusion Blennorrhea, Am. J. Ophth. **17**:1019 (Nov.) 1934.

4. Bedson, S. P., and Bland, J. O. W.: A Morphological Study of Psittacosis Virus with the Description of a Developmental Cycle, Brit. J. Exper. Path. **13**:461 (Oct.) 1932. Bedson, S. P.: Observations on Developmental Forms of Psittacosis Virus, ibid. **14**:267 (Aug.) 1933. Bedson, S. P., and Bland, J. O. W.: The Developmental Forms of Psittacosis Virus, ibid. **15**:243, 1934.

the usual inactivity of filtrates [5] of trachomatous materials might be due primarily to adsorption of the virus by the filter rather than to the large size of the particles. The following experiments have established the validity of this suggestion.

FILTRATION EXPERIMENTS

Fresh trachomatous material for the filtrations was obtained at White River,[6] the Apache Indian Reservation near Holbrook, Ariz., where a large number of Indian school children were available for study. Material for the experiments was obtained from fourteen patients with chronic trachoma, all with demonstrable pannus. Five African sphinx-baboons, chosen because this species was found to be uniformly susceptible to trachoma, were inoculated with filtered material. The filtration technic was identical with that used in the studies on inclusion blennorrhea,[3] with the exception that suspensions were cleared of gross particles by passage through filter paper instead of by centrifugation. Material was obtained by scraping the anesthetized conjunctivae (2 per cent butyn) with a platinum spatula; the removed epithelium was then suspended in a few cubic centimeters of sterile nutrient broth (p_H 7.6) and ground lightly in a mortar. The Jenkins filter, modified for collodion membranes, had a filtration area of less than 0.5 sq. cm. with the supporting perforated aluminum disk in position. The membranes, prepared according to the method of Elford,[7] were 0.3 mm. thick, with an average pore diameter of 0.75 microns. The filter was sterilized by boiling and the membranes by steaming. The filtrations were conducted under a negative pressure of less than 150 mm. of mercury and required less than five minutes in each case. The baboons were inoculated in both eyes by instillation of the filtrate and by light scarification of the conjunctiva with the charged needle.

EXPERIMENT 1.—Epithelial scrapings from three children were pooled, and the left eye of baboon 1 was inoculated with the filtrate. The right eye of the same baboon was inoculated with unfiltered material. Approximately one hour elapsed between the filtration and the inoculations. Cultures of the filtrate on blood agar slants showed no growth. Active follicular disease characteristic of experimental trachoma in this species was present in each eye two weeks after inoculation. There was no apparent difference between the lesions produced by filtered material and those produced by unfiltered material.

EXPERIMENT 2.—Scrapings from four patients were pooled, and both eyes of baboons 2 and 3 were inoculated with the filtrate. Cultures of the filtrate were

5. Lumbroso, U., and Thygeson, P.: Etudes sur la filtrabilité du virus trachomateux, Arch. Inst. Pasteur de Tunis **22**:178 (Aug.) 1933. For a review of the literature see the following articles: Weiss, C.: Present Knowledge of the Etiology of Trachoma, J. Infect. Dis. **47**:107 (Aug.) 1930; Olitsky, P. K.: Knutti, R. E., and Tyler, J. R.: Studies on the Filtrability of Bacterium Granulosis, J. Exper. Med. **54**:557 (Oct.) 1931.

6. The members of the Indian Service at White River cooperated in this study, and Dr. Polk Richards of the Indian Medical Service made arrangements for the material.

7. Elford, W. J.: A New Series of Graded Collodion Membranes, J. Path. & Bact. **36**:49, 1933; Proc. Roy. Soc., London, s.B **112**:384, 1933. Bauer, J. H., and Hughes, T. P.: The Preparation of the Graded Collodion Membranes of Elford and Their Use in the Study of Filtrable Viruses, J. Gen. Physiol. **18**:143 (Nov.) 1934.

negative. A mild follicular disease developed in both eyes of baboon 2. The eyes of baboon 3 showed abundant follicle formation with moderate inflammatory signs, the process being somewhat more marked in the left eye. The course in both animals was typical of experimental trachoma.

EXPERIMENT 3.—Material from three patients was pooled, and both eyes of baboon 4 were inoculated. Cultures of the filtrate were negative. A moderately intense follicular disease developed in both eyes. The infiltration and follicle formation on the caruncle and semilunar fold of the right eye were particularly striking.

EXPERIMENT 4.—The material from four patients was pooled. Both eyes of baboon 5 were inoculated, and a follicular disease of moderate intensity developed. Cultures of the filtrate were not made.

COMMENT

These four experiments demonstrate conclusively that epithelial scrapings from patients with trachoma contain a virus which is capable of passing through collodion filters impervious to conjunctival bacteria. This virus produces in baboons the same type of follicular disease as that produced by direct inoculation with trachomatous material. The identity of this virus with the etiologic agent of the disease appears more than probable, but it must be emphasized here that the results of animal experimentation in cases of trachoma must be checked on the human conjunctiva because of the impossibility of accurate diagnosis of trachoma in monkeys or apes.

The uniformly positive results in these experiments are attributed to the use of epithelial scrapings instead of expressed follicular material and to the use of collodion filters, with resultant minimal loss of virus in the filter due to adsorption. Both morphologic [1c] and experimental evidence [8] indicate that the agent of trachoma is an epithelial parasite.

The suggestion [9] has been made recently that the inclusion bodies of trachoma are the result of secondary infection with the agent of inclusion blennorrhea. Such a theory cannot be disproved by experiments on the eyes of monkeys, since the virus of inclusion blennorrhea produces in the monkey a follicular conjunctivitis which cannot be distinguished clinically or pathologically from the disease produced by direct inoculation with trachomatous material. The theory, however, appears extremely improbable from what is known of the epidemiology of inclusion blennorrhea and inclusion conjunctivitis. Most observers [10] agree that inclusions are demonstrable in 50 per cent or more of the

8. Michaïl, D., and Vancea, P.: Some Experimental Facts in Trachoma, Rev. internat. du trachome **9**:33 (Jan.) 1932.

9. Wilson, R. P.: Personal communication to the authors.

10. Bengtson, I. A.: The Epithelial Cell Inclusions of Trachoma: Experimental Studies, Am. J. Ophth. **12**:637, 1929. Thygeson, P.: Unpublished experiments.

active cases of trachoma in this country. Inclusion conjunctivitis appears here in sporadic cases and is not epidemic. The possibility of a non-epidemic disease secondarily infecting one half or more of the persons with trachoma seems extremely remote. Even such epidemic infections as conjunctivitis due to Diplococcus pneumoniae and Haemophilus influenzae complicate trachoma in a relatively small percentage of cases. Furthermore, inclusion conjunctivitis as an independent disease is self-limited, having a total duration of from three months to one year. There is no reason to believe that as a secondary infection in trachoma it could increase its duration to coincide with the duration of the trachomatous disease. In addition, it appears highly improbable that the virus of inclusion blennorrhea could be present in all four groups of cases used in the reported filtration experiments.

Further experiments are planned to determine whether or not trachomatous infection of blind human eyes can be produced with bacteria-free filtrates. Attempts will also be made to measure accurately the size of the particles of the virus of trachoma by means of graded collodion filters and to test the theory [2] which identifies the elementary body of trachoma with the virus.

SUMMARY

Four inoculations of baboons with bacteria-free filtrates of trachomatous materials resulted in a disease identical with that produced with unfiltered material. These experiments support the conclusions of Nicolle, Cuénod and Blaizot [11] that trachoma is a filtrable virus disease.

11. Nicolle, C.; Cuénod, A., and Blaizot, L.: Le magot animal reactif du trachome. Filtrabilité du virus. Pouvoir infectant des larmes, Compt. rend. Acad. d. sc. **155**:241, 1912. Nicolle, C.: Etat de nos connaissances d'ordre expérimental sur le trachome, Bull. Inst. Pasteur **19**:1 (Dec. 30) 1921.

CHEMISTRY OF THE VITREOUS HUMOR

III. LIPIDS

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The nature of the lipids of the vitreous humor has been of interest to ophthalmologists in their study of certain ocular diseases in which discrete particles which consist more or less of lipids are visible ophthalmoscopically in the vitreous humor. Although it is probable that in 1791 Schmidt [1] was the first to observe such bodies in the vitreous humor, not until the past twenty years has their occurrence been found to be fairly common. The clinical and microscopic characteristics and the origin of these particles have been incompletely investigated.

Lipid and nonlipid bodies in the vitreous humor were classified by Bachstez [2] as follows:

1. Bodies in the fluid vitreous—synchysis
   a. Synchysis scintillans: generally cholesterol crystals
   b. Synchysis nivea or albescens: white opacities which are possibly leucine or tyrosine
2. Bodies in nonfluid (scintillans) vitreous
   a. Poorly defined flakes of unknown chemical nature
   b. Globules (asteroid hyalitis) of calcium, and perhaps magnesium, soaps

The two kinds of nonlipid bodies of the vitreous humor need not be considered here. In synchysis scintillans the glistening crystals of the vitreous humor have been identified as cholesterol by Clapp [3] and others. No effort was made to determine whether or not the cholesterol was free or esterified. Globules in nonfluid vitreous are composed essentially of calcium soaps. Verhoeff [4] presumably found calcium, lipid and car-

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1. Wiegmann, E.: Ein Beitrag zur Genese und zum Bilde der Synchysis scintillans, Klin. Monatsbl. f. Augenh. **61**:82, 1918.

2. Bachstez, E.: Ueber den klinischen, chemischen und histologischen Befund bei der Scintillio corporis vitrei, Ztschr. f. Augenh. **54**:26, 1924.

3. Clapp, C. A.: Crystalline Deposits in the Vitreous; Report of Two Cases of Calcium Soap, Studied Microscopically and Histochemically, Arch. Ophth. **2**: 635 (Dec.) 1929.

4. Verhoeff, F. H.: Microscopic Findings in a Case of Asteroid Hyalitis, Am. J. Ophth. **4**:155, 1921.

bonate in the globules. His conclusions that margarate and lecithin were present were not based on the evidence he presented. Bachstez [5] reported that the globules consisted of calcium soap. Poljak [6] showed that they were not tyrosine or cholesterol. Holloway and Fry [7] reported the presence of calcium carbonate and soap and the absence of unsaturated soaps and cholesterol. The chemical tests which have been made on the particles for fatty acids have shown only that a lipid is liberated by treatment with mineral acid. It is reasonable to suppose that the globules are calcium and perhaps magnesium soaps of saturated fatty acids, such as stearic and palmitic acids.

The source of part of the lipid of these discrete masses in the vitreous humor may be considered to be the vitreous lipid which occurs naturally, if the results of the previous analyses are accepted. The published reports on the total amount of vitreous lipids, consisting of fat, phospholipid and free cholesterol, have ranged from 2 to 200 mg. per hundred cubic centimeters of fluid.[8] Experience with the analysis of ocular lipids has led me to believe that the reported values for vitreous lipids are remarkably high. For this reason, the present investigation was begun.

METHOD

The bovine eyes were removed immediately after the slaughter of the animal. Abnormal eyes were rejected. The corneas were removed by section. The iris and lens were removed by forceps and the vitreous humor was shelled out. The vitreous humor was carefully and minutely examined by transmitted light, and all foreign material, such as pigment and fragments of attached retina, was removed. In case of any doubt of the purity of the vitreous humor it was discarded. The analytic method which was used for the extraction and the determination of the lipids of the vitreous humor has been described in a previous publication [9] and need not be given here. The lipids were determined by extraction of the vitreous humor with alcohol and purified petroleum benzin, U. S. P., before and after alkaline hydrolysis. In the early analyses, the results of which are not recorded here, it was found that the total amounts of lipid varied widely in spite of the use of eyes that were removed as fast as possible from the animals. The variations were due to the lack of critical examination and removal of the attached retina which was not seen during gross inspection.

5. Bachstez, E.: Fettsauerer Kalk als Grundlage einer Art von Scintillatio corporis vitrei, Wien. med. Wchnschr. **71**:1044, 1921.

6. Poljak, G. P.: Synchisis scintillans camerae anterioris, Ztschr. f. Augenh. **65**:85, 1928.

7. Holloway, T. B., and Fry, W. E.: Asteroid Hyalitis: Report of a Case with Microchemical and Histologic Observations, Arch. Ophth. **2**:521 (Nov.) 1929.

8. Krause, A. C.: The Biochemistry of the Eye, Baltimore, Johns Hopkins Press, 1934.

9. Krause, A. C.: The Lipids of the Sclera, Cornea, Choroid and Iris, Am. J. Physiol. **110**:182, 1934.

RESULTS

The analysis of lipids of bovine vitreous humor is given in the table.

The lipids of one sample of pig vitreous humor amounted to 0.6 mg. of total lipids per hundred cubic centimeters of fluid and 0.11 mg. of cholesterol before hydrolysis and 1.1 mg. of total lipids and 0.2 mg. of cholesterol after hydrolysis, or a grand total of 1.7 mg. of total lipids and 0.31 mg. of cholesterol. No cholesterol was found as a fatty ester.

The leukocytes were removed from 1,500 cc. of bovine blood. They weighed 266.4 mg. and contained 39.2 mg. of total lipids, of which 8 mg. was free cholesterol and 5.3 mg. was cholesterol ester. Since bovine blood contains an average of 9,000 leukocytes per cubic millimeter, the amount of total lipids and cholesterol per cell is easily calculated.

Lipids of the Vitreous Humor of Cattle from 2 to 4 Years Old

Sample	I (2,961 Gm.), Mg.	II (2,181 Gm.), Mg.	III (2,495 Gm.), Mg.
Before hydrolysis			
Total lipid	1.600	1.200	2.20
Cholesterol	0.002	0.024	0.12
After hydrolysis			
Total lipid	5.800	1.800	1.80
Cholesterol	0.610	0.260	0.18
Total lipid	7.400	3.000	4.00
Total cholesterol	0.612	0.284	0.30

COMMENT

The lipids of these bodies in the vitreous humor may come from the lipids of the blood, the vitreous humor or the surrounding tissues. There is no reason to suspect a hematogenous origin of the lipids. In these diseases intra-ocular hemorrhages are not evident. Moreover, intra-ocular hemorrhages do not seem to give rise to lipid bodies in the vitreous humor. An abnormal amount of lipids in the blood and feeding of various lipids has not produced visible deposits in the vitreous humor. In the vitreous humor the lipids are present in such small quantities that even after pathologic proteolysis of the vitreous they would not be visible macroscopically. Furthermore, the quantity of lipid calculated from the number and average size of the lipid particles as recorded by Verhoeff is much greater than that of the normal vitreous humor. Since there is no evidence that the vitreous humor has a metabolism of its own it is not likely that it acquires a pathologic metabolism of lipids.

It is probable then that the lipid particles come indirectly from other tissues. The adjacent tissue is the retina which contains a large per-

centage of fatty acid and cholesterol. Since the diffusibility of large lipid molecules into the colloidal vitreous humor from the retina presumably is exceedingly slight, unless the process of diffusion were to last for a long time it is not likely that rhythmic precipitation would occur. The other possibility is the transportation of the lipids from degenerated tissue by leukocytes. Leukocytes of the phagocytic type contain lipids, which are greatly increased in amount during the normal active response of the tissues to disease, and the leukocytes may also contain lipids of their own that are acquired from degenerated tissues. It is probable that the migratory phagocytes pass into the vitreous humor and die, disintegrate and leave the lipids as inert particles. The kind of lipid may be dependent on the type of leukocyte transporting the lipid.

CONCLUSION

In normal bovine vitreous humor the amount of lipid is less than 0.014 mg. per hundred cubic centimeters of fluid and the amount of cholesterol less than 0.012 mg. A part of the lipid and cholesterol is bound to the proteins. No cholesterol fatty acid ester is present. The glistening particles of cholesterol and the calcium soaps in the vitreous humor probably arise from the liberation of the lipids of the leukocytes.

The material was obtained through Mr. R. L. Fox. The technical procedures were performed with the aid of Mr. W. Tauber.

ORTHOPTIC TREATMENT OF SQUINT

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The efficacy of muscular exercise in increasing the strength of the skeletal muscles is so apparent to physiologists and to the laity alike that by a fallacious analogy the idea has an inherent appeal to almost all patients when it is applied to the problems of ocular dysfunction. The deceptive simplicity of this idea has permitted orthoptic training to assume a place in ocular therapeutics almost as secure as the ophthalmologic panaceas—yellow mercuric oxide and boric acid—substances which are regarded with superstitious reverence as "something good for the eyes." It is hardly necessary to point out that wrong diagnosis, poor refraction, vertical muscular imbalance and aniseikonia [1] are frequently responsible for the failure to obtain the relief from symptoms for which orthoptic training is so glibly prescribed.

We agree with Hofmann and Bielschowsky [2] that the limits of the fusion movements are not rigid and that their amplitudes may be increased by practice. Increasing the amplitude of the fusion movements plays only a small part in the orthoptic training of a patient with strabismus. Of all the fusion movements convergence is the only type under the control of the will [3] and is most easily developed, yet divergent strabismus is considered by most authorities to be the most difficult to correct by orthoptic training. One may also see a patient in whom the amplitude of the fusion movements, including convergence, is normal but who previously had a convergent strabismus. In such a patient, if fusion is broken by covering one eye in order to permit it to take its position of rest, it will be found to be in a position of overconvergence. If the targets of the haploscope are then moved, or prisms base out are

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1. Doane, Howard C.: The Clinical Significance of Differences in the Relative Size and Shape of Ocular Images, Tr. Am. Acad. Optometry **8**:117, 1933.

2. Hofmann, F. B., and Bielschowsky, A.: Ueber die der Willkür entzogenen Fusionsbewegungen der Augen, Arch. f. d. ges. Physiol. **80**:1, 1900.

3. Bielschowsky, A.: Lectures on Motor Anomalies of the Eyes: I. Physiologic Introduction, Arch. Ophth. **12**:805 (Dec.) 1934; II. Paralysis of Individual Eye Muscles, ibid. **13**:33 (Jan.) 1935; III. Paralyses of the Conjugate Movements of the Eyes, ibid. **13**:569 (April) 1935; IV. Functional Neuroses: Etiology, Prognosis and Treatment of Ocular Paralysis, ibid. **13**:751 (May) 1935.

used until binocular vision is again established, fusion movements of convergence will be found to be greatly increased, while the divergence movements will not be great enough to bring the eyes to parallelism.

The object of orthoptic training for patients with strabismus is to develop binocular vision. A fairly detailed knowledge of the physiology of binocular vision is essential to a proper selection of the cases in which orthoptic training may logically be expected to produce demonstrable results.

Binocular vision is a single mental impression elaborated from two fused monocular sensations. This faculty is of late phylogenetic acquisition and is present only in primates.[4] It is a process of considerable complexity and is made up of two separate stages. A sensory image is first elaborated by each of the two monocular mechanisms, and if the images are suitable, they are then fused into one image by a perceptive process at a higher level. The process by which the faculty of binocular perception is acquired is considered to be a learned mental process, a facilitation of reflex paths similar to the development of conditioned reflex paths. Weymouth and Andersen [5] reported that they had demonstrated that binocular vision normally develops early in childhood and has in most cases reached a high degree of stability by the time the child is 6 years old. Worth,[6] as long ago as 1903, stated that unless binocular vision is established by the seventh year, it is rarely established at all.

O'Connor [7] has long believed that orthoptic training is unnecessary in cases of crossed eyes if the eyes are straightened by early operation. Bielschowsky [8] questions the value of orthoptic training in all except a few selected cases. However, there are many excellent authorities who use orthoptic training and believe it to be of great value. Peter,[9] Guibor,[10] and Filliozat [11] and Maddox [12] recently published articles in

4. Smith, Elliot: The Evolution of Binocular Vision, Tr. Ophth. Soc. U. Kingdom **45**:53, 1925.

5. Weymouth, F. W., and Andersen, E. E.: Visual Perception and Retinal Mosaic: I. Retinal Mean Local Sign; an Explanation of the Fineness of Binocular Perception of Distance, Am. J. Physiol. **64**:561 (May) 1923.

6. Worth, C. A.: Squint, Philadelphia, P. Blakiston's Son & Co., 1903.

7. O'Connor, Roderic: Personal communication.

8. Bielschowsky, A.: Personal communication.

9. Peter, L. C.: Symposium on the Treatment of Non-Paralytic Squint, Tr. Ophth. Soc. U. Kingdom **52**:325, 1932.

10. Guibor, G. P.: Some Possibilities of Orthoptic Training: A Comparative Study of a Control Group and a Treated Group of Patients with Squint, with Remarks Concerning the Technic Used in Orthoptic Training, Arch. Ophth. **11**:433 (March) 1934.

11. Cantonnet, A., and Filliozat, J.: La strabisme, Paris, Norbert Maloine, 1932.

12. Maddox, M.: The Orthoptic Treatment of Strabismus, Tr. Ophth. Soc. U. Kingdom **51**:296, 1931.

which they acclaimed the use of orthoptic training in the treatment of squint.

If binocular vision is to be obtained, the following conditions must be fulfilled:

1. There must be good monocular fixation and projection in each eye.

2. The visual acuity in the two eyes must be approximately equal.

3. An image of approximately the same size and shape must be received from each retina, and corresponding retinal points must be able to function in association with each other.

4. There must be a large overlapping field of vision and only partial decussation of the optic tracts.

5. The neuromuscular motor mechanism of each eye must function normally alone and in association with the fellow eye.

6. The higher cerebral centers must be capable of fusing the two monocular sensations.

In order for an eye to possess good monocular fixation, it is essential that there be a central area which possesses a well developed, fine discriminating power and that this area be capable of being automatically directed in such a way that the retinal image falls within it. This is accomplished by the psycho-optical reflex of fixation.[12a] When light falls on a peripheral point of the retina, the eye is either consciously or subconsciously moved in such a way that the image falls on this well developed area. The movement is rapid and there is an overshooting of the mark with subsequent adjustment by means of small corrective movements. Once the object is fixed, it is judged to occupy a definite position in space and to have a definite position in relation to the body. This judgment as to the position occupied by an object in space is the result of proprioceptive impulses which arise in the muscles that keep the body erect, in the muscles of the neck and of the labyrinth and in the extra-ocular muscles.

If the patient is asked to use only the squinting eye and to trace by a series of broken lines on transparent paper the course of a straight line beneath the paper, he will frequently fail to superimpose the lines. If he has false projection he will draw all the broken lines on one side of the original, whereas if he has merely poor vision the broken lines will be about equally distributed on the two sides of the original line. A patient who has false projection likewise will state that similar pictures are superimposed when the amblyoscope is set at an angle markedly different from the angle of deviation. False projection is a definite barrier to successful orthoptic and surgical treatment of strabismus unless steps are taken to overcome it.

12a. Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1933, vol. 1, p. 612.

Howard,[13] Deyo [14] and Weymouth and Andersen [5] showed that a person's ability to judge distance either monocularly or binocularly varies directly with his visual acuity. What is even more important in the treatment of squint is that the vision in the two eyes must become about equal before one can expect binocular vision to develop. In fact, it is more important for the visual acuity to be approximately the same in the two eyes than for it to be normal. As soon as the difference in the visual acuity between the two eyes amounts to more than the ratio of 1 to 0.66 (6/6 to 6/9 or 20/20 to 20/30), one begins to find an impairment in binocular vision, and when the difference amounts to more than the ratio of 1 to 0.28 (6/6 to 6/22, or 20/20 to 20/70), the two eyes cannot be used together and the image of the poorer eye is usually suppressed.[15] If a person who has even a moderate degree of muscular imbalance but normal visual acuity looks through a smoked glass of sufficient density to reduce the vision in one eye to below 20/70, he will find difficulty in fusing the two images of such an object as a small muscle test lamp at 20 feet (6 meters). The effect of the difference of visual acuity in the two cases on stereoscopic vision is also well demonstrated by a simple experiment which is based on the Pulfrich stereophenomena.[16] When an observer with approximately equal visual acuity in the two eyes looks at a pendulum in motion, it seems to swing in one plane. If the vision of one eye is moderately reduced by placing a smoked or colored glass before it, the pendulum appears to swing in an ellipse. If the vision in one eye is still further reduced below a certain level, the illusion of swinging in an ellipse ceases and once more the pendulum seems to swing in one plane because the image in the obscured eye has been completely suppressed.

Anything which tends to render the images from the two eyes unequal will have the same effect, and if the disturbance is too great for comfort, nature gives relief by suppressing the image from one eye. There are but two ways in which a person who is confronted with dissimilar images can obtain comfort: by suppressing the image from the poorer eye or by turning the poorer eye away from the point of fixation so that the image will fall on a region of the retina so functionally inferior that it becomes a subliminal stimulus.

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13. Howard, H. J.: A Test for the Judgment of Distance, Am. J. Ophth. **2**:656, 1919.

14. Deyo, B. V.: Judgment of Distance: Monocular and Binocular Judgment of Distance, Am. J. Ophth. **5**:343, 1922.

15. Adler, F. H.: Clinical Physiology of the Eye, New York, The Macmillan Company, 1933.

16. Pulfrich, quoted by Lloyd, Ralph: The Etiology of Strabismus, Arch. Ophth. **7**:934 (June) 1932.

Macular suppression and amblyopia exanopsia are definite hindrances to the successful development of binocular vision. Success in the treatment depends on the reduction or, finally, the elimination of the central scotoma due to suppression.

Henschen [17] showed that the visual cortex possesses certain unique morphologic characteristics. This area is made up of two main layers, a superficial layer of nerve cells and a deep layer of nerve fibers, which come from the cells of the external geniculate body. The nerve cells of the superficial portion are arranged in three layers. When both eyes are lost early in life, the superficial and the deep layer of these cells become atrophic, but the middle layer remains intact. If one eye is lost early in life, the cells of the deeper layer on the opposite side of the brain and the superficial cells on the same side of the brain are found to be atrophied. Henschen, therefore, regarded the middle layer of cells as being functionally independent and believed them to be the final receptors, which are bordered above and below by cells in layers which are connected with functionally related points of each retina (corresponding retinal points). If fusion is to occur, approximately corresponding cells in the deep and in the superficial layer must be stimulated; that is, sensation from images of approximately similar size and shape must be presented to the brain from each monocular mechanism.

The size and shape of the retinal image is determined by the power of refraction of the eye and the distribution of the receptor elements of the retina. This distribution has been called by Weymouth [18] "retinal grain." It has long been known that when there is anisometropia beyond a certain degree the two eyes cannot be used together. Aniseikonia was studied by Ames and his co-workers in the department of physiologic optics at the Dartmouth Medical School. They measured the size and shape of retinal images in persons with binocular vision and found that the difference is always less than 4 per cent,[19] and as the upper limits are approached, suppression of one image becomes frequent.[20] They also made the same determination in cases of alternating strabismus with good vision in one eye and found evidence of a

17. Henschen, S. E.: Die Vertretung der beiden Augen in der Sehbahn und in der Sehrinde, Arch. f. Ophth. **117**:403, 1926; Zur Anatomie der Sehbahn und des Sehzentrums, ibid., p. 419.

18. Weymouth, F. W.: Unpublished lectures on the physiology of the retina.

19. Ames, A., and Gliddon, G. H.: The Importance of the Relative Size and Shape of Ocular Images in Vision, Ann. Distinguished Serv. Foundation Optometry **1**:46, 1932.

20. Madigan, L. F., and Carleton, E. H.: A Clinical Report of the Correction of Differences in the Size and Shape of Ocular Images, Ann. Distinguished Serv. Foundation Optometry **1**:71, 1932.

difference in size in over 4 per cent. From these observations it may be deduced that orthoptic training will probably be of no value in any case in which it is impossible to correct the size and shape of the retinal images so that they differ by less than 4 per cent.

The routine detection of aniseikonia must await the development of apparatus that can be used clinically, and its correction will not be possible until suitable isekonic lenses are available. Ames and his co-workers, in association with the American Optical Company, are now working on such apparatus and lenses.

If the phylogenetic development of the eye is traced it is found that there is a gradual change of the eyes from the lateral to the frontal position. A similar change can be followed also in ontogeny. This change has been accompanied by a corresponding alteration in the optic tracts. In fish there is a complete decussation. Higher in the scale, for example, in lower mammals such as rabbits and cats, there is usually a small binocular field. Correspondingly, in these animals there are some fibers which do not decussate at the chiasm. In the primates, in which the visual axes have approached parallelism and the snout has receded, the binocular field comprises the greater part of the whole and there is a decussation of only slightly more than half of the fibers of the optic nerve.

For binocular vision not only is it necessary for each eye to be equipped with a mechanism capable of moving it with great precision and delicacy, but there must also be some coordinating mechanism which keeps the eyes in a more or less definite relationship to each other so that corresponding areas of each retina are projected to the same point in space. This coordination is not structurally determined but is a non-rigid physiologic process. This fact is of importance to the wearer of spectacles because as the eyes move behind the lenses there is a continuous change in the amount of effective prism. To preserve the mutual relationship of the eyes to each other, there is in the brain stem a complicated series of connections between the nuclei of the various extra-ocular muscles through the posterior longitudinal bundle.

There are three cortical centers[21] which send afferent fibers to the common motor paths of the ocular muscles, and each of these performs a different function in controlling the ocular movements. The impulses to voluntary movements arise in the frontal area, while the occipital areas control reflex movements which arise from retinal stimulation. The temporal centers control reflex motions which follow acoustic stimulation or stimulation of the semicircular canals. Any impairment of these pathways will interfere with orthoptic training.

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21. Spiegel, E. A.: Physiopathology of the Voluntary and Reflex Innervation of Ocular Movements, Arch. Ophth. **8**:738 (Nov.) 1932.

Double or alternating hyperphoria [22] is a closely allied condition of neurologic origin which, however, does not interfere with the development of binocular vision.

In a study of the mechanism of the fusion of the two sensory presentations it is necessary to leave the field of physiology and enter the more or less speculative field of psychology. To study the complex psychologic process of fusion, one must begin by studying the process in its simplest form. This can be done by stripping the stimulus of most of its attributes.

Sherrington [23] and others, working with simple types of stimuli, have shown that each binocular component develops a complete sensation, and if on introspection they are found to be alike, they are fused, and the product does not differ from either of its components. If, however, on introspection the presentations from the two uniocular mechanisms are found to differ widely, then a condition of rivalry results which may result in a complete suppression of one component in favor of the more powerful sensation, or an oscillatory suppression of first one and then the other sensation. Between these two extremes there are sensations which differ with regard to some quality and out of which a single binocular perception is developed intermediate between the two components. Thus the singleness perceived in binocular vision is a synthesis that works on already elaborated sensations.

With these principles in mind we have attempted to evaluate critically the results of a series of cases from the Children's Hospital.

Each of the new patients with squint who was seen in the Eye Clinic was carefully classified as to the type of squint presented and as to constitutional makeup. Any patient with a physical defect, such as nystagmus, disease of the refracting media or of the retina and optic nerve, or any mental defect, such as feebleminded-ness, was excluded from this series.

The ophthalmologic examination included the determination of the visual acuity, measured with the E chart and the Wellsworth kindergarten chart, and recently with the Bailey visual perception test. The degree of deviation was measured for distant and near vision first without and then with glasses, and the degree of deviation was recorded as the number of prism diopters necessary to abolish motion when the eyes were alternately covered and uncovered. When the deviation was greater than 60 prism diopters, it was recorded as such. The fixing power of each eye was noted in the primary position, and the ability of each eye to follow a light in various directions was determined and any vicarious movements were recorded. The monocular excursion of each eye in four directions (temporal, nasal, upward and downward) was determined with the tropometer.

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22. Bielschowsky, A.: Die einseitigen und gegensinnigen (dissoziierten) Vertikalbewegungen der Augen, Arch. f. Ophth. **125**:493, 1931.

23. Sherrington, C. S.: The Integrative Action of the Nervous System, New York, Charles Scribner's Sons, 1906; On Binocular Flicker and the Correlation of Activity of "Corresponding" Retinal Points, Brit. J. Psychol. **1**:26, 1904.

In any case in which vicarious movements or evidences of them were found, the screen deviations in the six diagnostic directions of the gaze were determined.

The refraction was then determined after the routine instillation of a 1 per cent solution of atropine sulphate in each eye alternately morning and night for three days. The full correction less about 0.5 diopter sphere was prescribed for constant wear. At the end of two or three months, if no improvement was noted, the refraction was again determined after the instillation of atropine sulphate, and the glasses were changed if necessary.

If one eye was found to be amblyopic, it was treated by bandaging the other eye for from four to eight hours a day. In suitable cases older children were sent to the movies once or twice a week with the good eye occluded.

In some of the first cases atropine was prescribed to be used every other day in the fixing eye so as to force the patient to use the squinting eye. It was soon observed that in many cases the visual acuity in the squinting eye was so low that the patient continued to use the atropinized eye and, therefore, the visual acuity in the squinting eye did not improve. This procedure was therefore discontinued

TABLE 1.—*Operative Results in Cases in Which No Orthoptic Training Was Given*

	Cosmetic Results			
	Eyes Straight*		Eyes Not Straight	
	Muscle Balance D>5△ N>5△	Muscle Balance D<5△ N<5△	Deviation Small, But Cosmetically Good	Deviation Large, But Cosmetically Poor
Number of patients	13.0	7.0	2	2.0
Average age in years	7.7	6.4	6	7.5
	Functional Results			
	Third Degree Fusion	Second Degree Fusion	First Degree Fusion	No Fusion
Number of patients	8.0	8.0	2	6.0
Average age in years	8.5	6.2	6	6.2

* D indicates distance; N, near.

in favor of placing a patch over the better eye for a definite period each day. At the present time we are using a continuous patch in several of the stubborn cases, and this seems to be producing results when other methods have failed.

Those patients whose eyes remained straight when glasses were worn were not subjected to orthoptic training. The remaining patients, those whose eyes did not become straight with the wearing of glasses and following occlusion treatment, were divided into two groups. The patients in the first group were operated on and the results that were obtained are shown in table 1.

The second group consisted of twenty-four patients with convergent strabismus, eight with divergent strabismus and four with external deviation following a previously performed tenotomy of an internal rectus muscle. These thirty-six patients, who ranged in age from 3 to 13 years, were given orthoptic training over a period of time which varied in length from two to nine months. The eyes had been refracted at least twice, and the patients had worn glasses constantly for at least six months and had received some treatment for amblyopia. They received orthoptic training twice a week at the clinic and in addition were given various forms of orthoptic exercises to perform at home.

The various types of apparatus used at the clinic were the cheiroscope, the Wells stereo-optometer with Wells charts, the Worth-Black amblyoscope, the

stereo-orthopter and the Keystone stereoscope and views. Treatment at home consisted of the use of the Worth-Black amblyoscope, the orthostereoscope, the stereoscope with the Wells series of stereoscopic charts and the Keystone views, loose prisms and monocular training with the good eye occluded and binocular tracing with the bichrome glasses. The technic used was in general that recommended by the manufacturers of the various appliances. The results of exercise are given in table 2.

RESULTS

An analysis of the twenty-four cases of patients with convergent squint who were given orthoptic training shows that in no case were the eyes straight without glasses and in only five cases were they straight with glasses. In these five cases the refractive errors were approxi-

TABLE 2.—*Results of Orthoptic Training*

	Number of Patients	Average Age, Years
Esotropia		
Cosmetic results		
Straight with or without glasses	0	0
Straight with glasses	5	8
Less deviation	4	6½
Unchanged deviation	15	6½
Functional results		
Fusion, third degree	13	6½
Fusion, second degree	5	7
Fusion, first degree	4	7
No fusion	2	13
Exotropia		
Cosmetic results		
No lasting improvement		
Functional results		
Fusion, third degree	6	12
Fusion, second degree	1	15
Fusion, first degree	1	11
No fusion	0	0
Postoperative exotropia		
Functional results		
Fusion, first degree	1	12
No fusion	3	6

mately 3, 5, 7, 8 and 10 diopters of hyperopia, respectively. Fixation was good with either eye; there was no false projection or underacting or overacting of the muscles (except in the patient with 10 diopters of hyperopia, in whom there was a slight weakness of one external rectus muscle); the visual acuity in the two eyes was or became about equal but not necessarily normal, and in all the patients third degree fusion developed. The apparent cause of the squint in the cases was hyperopia. When this cause was removed by correcting the hyperopia, the eyes did not become straight, nor did they become straight when the visual acuity in the squinting eye was improved to approximate equality, but they did become straight when coordination was established by orthoptic training. We believe that this is the only type of squint in which there will be a successful response to orthoptic training.

Fourteen of our patients had a weakness of one or both external rectus muscles, and there was a weakness of one or both superior rectus muscles in three patients. Only one of these patients showed any cosmetic improvement, although in nine third degree fusion developed.

In one of the two cases in which we could not produce even first degree fusion, the vision in the squinting eye could not be improved to 20/200; in the other, the vsion was about equal in the two eyes, but there was marked aniseikonia, the degree being great enough to be qualitatively determined by rough tests.

Third degree fusion was developed in thirteen patients. This degree of fusion is of great value when the eyes are surgically straightened. Seven of the patients who received orthoptic training and in whom third degree fusion developed were subsequently operated on with excellent cosmetic and functional results. Two patients in whom first degree fusion was not obtained were operated on with only fair cosmetic and poor functional results.

It must be remembered, however, that the seven patients in whom third degree fusion was obtained with orthoptic training might have acquired it equally well after operation alone. We found, as Dr. O'Connor and others had previously observed, a substantial number of patients who had binocular vision with depth perception after operation but who had received no orthoptic training. It will be recalled that in our series of cases in which operation was performed eight of the twenty-four patients had third degree fusion after operation without receiving any orthoptic training.

No lasting result was obtained in any of the eight patients with exotropia who received orthoptic training. Three of the patients acquired a high degree of duction for both distant and near vision during treatment, but in a short time after the treatment was discontinued they quickly reverted to their original status. Four others did not show even temporary improvement, and one child with a typical Bielschowsky syndrome became so uncomfortable that he had to remain out of school because of the disturbing double vision. This, however, disappeared in a few days.

Two patients with exotropia, each of whom had had an unguarded tenotomy of one internal rectus muscle, and two other patients, each of whom had had an extensive partial tenotomy of one internal rectus muscle together with an O'Connor cinch shortening of the external rectus muscle of the same eye, exhibited no improvement following orthoptic training.

SUMMARY

Although our number of cases is too small to warrant the tabulation of percentages, we believe that we may conclude that:

1. Orthoptic training is of value in developing fusion, but it has a limited value in straightening crossed eyes.

2. It will not correct anatomic abnormalities, which are the contributory causes in many cases of strabismus.

3. It is of no value to attempt to develop binocular vision unless the visual acuity is about equal in the two eyes.

4. It is probably of no value to attempt to develop binocular vision in the presence of aniseikonia.

5. If the necessary steps are taken to develop visual acuity in the squinting eye, to break down suppression, to correct false projection and to correct refractive errors, and if the patients with paresis and aniseikonia (who are not helped by orthoptic training) are excluded, the number of remaining patients with strabismus who will benefit from orthoptic treatment is relatively small.

DISCUSSION

Dr. Walter B. Lancaster, Boston: I will not detain the members longer than to express my satisfaction at finding the subject presented in such a scientific manner. I think it gives promise of real progress because I have not seen any paper on the subject which shows such a grasp of the underlying physiologic and psychologic principles, without which one is groping in the dark.

Dr. Sanford R. Gifford, Chicago: I agree with Dr. Lancaster as to the scientific basis for this paper but I should like to give a little more encouragement by saying that it is not necessary for the vision of the two eyes to be as nearly alike as Dr. Hicks thought from his work. Successful results can be obtained when the vision of one eye is 20/50 or better. My associates and I consider 20/80 as the point beyond which nothing can be done. Certainly a person with vision of 20/50 in one eye and 20/20 in the other can be trained to use the two eyes together.

In some cases of squint of low degree (15 degrees) the eyes can be straightened by orthoptic training, as illustrated by some of the pictures that I showed at the meeting yesterday.

Dr. M. N. Beigelman, Los Angeles: There is no unanimity of opinion among authorities on orthoptic training as to the indications for its use, the methods which are most satisfactory or the percentage of good results obtained.

Among modern authors Cantonnet has claimed a 70 to 80 per cent incidence of cures, while Onfray stated that he was content with 25 per cent. If orthoptic training is to occupy a place in the management of strabismus, the type of patients who will respond to it must be determined.

I believe it is the primary duty of investigators to analyze their unsuccessful cases, to determine the reasons for failures and to help outline more clearly the sphere of usefulness of orthoptic treatment. It must be remembered that this is a psychophysiologic method in which

the general principles are simple and easy to grasp but that success depends not on those general principles but on the technic and on the detailed work, which must be painstaking and which will vary with each patient.

It is to be hoped that those who devote their time and energy to orthoptic treatment will escape the fate of the ingenious Javal, the originator of modern orthoptic training. At the end of his career Javal, who had to his credit a larger percentage of good results than any other worker, stated: "Although there are few incurable cases of strabismus, the re-educational cure does not deserve the effort it demands."

DR. EDWARD JACKSON, Denver: The paper and some of the discussions have brought out the fact that an attempt is being made to create binocular vision, which is a psychophysiologic process, in a person who has not used his two eyes together. It is an education that depends on the efforts of the subject. This is a difficult goal to reach, and it is to be obtained only by the psychologic approach.

DR. AVERY M. HICKS, San Francisco: I appreciate Dr. Lancaster's compliment very much.

I probably gave the impression that it is necessary for the visual acuity to be practically the same in the two eyes before binocular vision develops. Our experience made us think that the vision in the poorer eye had to be about 20/40 before fusion could be obtained. If the difference in the visual acuity was greater than that between 20/20 in the better eye and 20/70 in the poorer eye, I was unable to convince myself that the patient actually obtained true stereoscopic vision.

Aniseikonia is a problem about which Dr. Ames and his co-workers at Dartmouth have recently written a number of papers, but I believe it is too early to evaluate the study of this condition.

There is no question but that in one of our cases, in which fusion could not be developed, there was a marked difference in the relative size and shape of the retinal images. It could be shown with crude targets and the amblyoscope that when a square was viewed first with the right and then with the left eye, it appeared definitely elongated and narrower with the left eye. The patient was unable to fuse objects which have form, such as the E and the L in the amblyoscope, but was able to superimpose flat objects which contain no form.

Differences in the relative size and shape of the retinal images may account for the unusual results obtained in a second case. The patient had an alternating strabismus. The refractive error was +0.75 sph. ⊃0.75 cyl. axis 90°. On several occasions, when the patient was between 3 and 3½ years of age, the visual acuity was recorded as 6/10 in each eye by at least four different observers. At the age of 3½ years, the eyes were set straight by operation and an almost perfect cosmetic result was obtained. By means of the cover test the eyes showed 2 prism diopters of esophoria at the distant and 2 prism diopters of exophoria at the near point. In spite of the fact that the eyes are perfectly straight, the vision in one eye has gradually diminished until at the present time it is less than 20/200. There is no ophthalmoscopic evidence of a lesion to account for this reduction of vision and there has been no change in the refractive error.

ACUTE PURULENT CONJUNCTIVITIS DUE TO THE MENINGOCOCCUS

REPORT OF A CASE

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AND
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The occurrence of acute purulent conjunctivitis due to the meningococcus in an otherwise healthy person is exceedingly rare. Its occasional occurrence, however, and that of conjunctivitis due to Micrococcus catarrhalis illustrate the value of culture in certain cases in which differentiation from gonorrheal ophthalmia is important and would be otherwise impossible.

REPORT OF CASE

George G., aged 7 years, the son of a physician, was seen in April 1933 with chronic bilateral conjunctivitis. A few gram-negative diplococci were found in conjunctival scrapings, but on account of the mildness of the subjective and objective symptoms no complete bacteriologic study was made, and the organism was considered as probably M. catarrhalis. The symptoms subsided within a few weeks with the use of a mild antiseptic, though some enlarged follicles remained.

On Dec. 11, 1934, during a moderately severe cold, the boy complained of a sudden pain in the left eye, which continued throughout the night. When he was seen the next morning the left lids were much swollen, a profuse purulent discharge was present in the conjunctival sac and the conjunctiva was everywhere swollen and beefy red. In the center of the cornea was an area in which the corneal reflex was dull, but the area did not stain with fluorescein. The right eye was normal. Numerous gram-negative diplococci were present in smears, both intracellular and extracellular, and cultures were made. No history of possible contact with persons having conjunctivitis or gonorrheal infection could be elicited. A protective shield was placed over the right eye, and hourly irrigations were prescribed for the left eye.

The next day the symptoms were the same, and in addition a large central corneal erosion was present. The child was hospitalized with the care of a day and a night nurse; he was given irrigations of physiologic solution of sodium chloride every half-hour and metaphen (1:2,500) twice a day, and 6 cc. of sterile milk was injected intramuscularly. The injection was repeated after forty-eight hours. Smears again showed numerous gram-negative diplococci.

The swelling and discharge speedily subsided, and the corneal erosion healed rapidly. On the fourth day it no longer stained, and the discharge was scanty.

On December 20 no discharge was present, and the corneal scar was barely perceptible. Epithelial scrapings revealed no organisms on direct examination,

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and cultures showed only Staphylococcus albus. The right eye, which was kept under a shield until discharge from the left eye had ceased, never showed any signs of inflammation. No general symptoms were noted except those due to the moderate febrile reactions from the injections of milk.

Cultures of material obtained on the first day were made on blood agar and Löffler's serum. A scanty growth of gray, slightly opaque, smooth colonies was present in twenty-four hours on both mediums. Both proved to be pure cultures of a gram-negative diplococcus. Subcultures on blood serum, blood agar and ascitic agar grew scantily. No hemolysis occurred on the blood plates. No yellow color was present in the colonies.

Fermentation tests with this organism were positive with dextrose and maltose and negative with lactose, saccharose, galactose, dextrin, inulin, salicin, levulose and mannitol. The agglutination reactions are shown in table 1.

TABLE 1.—*Agglutination Reactions*

Serums	20	40	80	160	320	640	1280	2560	5120	Control
Antimeningococcus (poly)	++++	++++	++++	+++	++	++	++	++	—	—
Antigonococcus (T34)	+++	++	+	—	—	—	—	—	—	
Normal rabbit	—	—	—	—						

TABLE 2.—*Fermentation Reactions of the Gram-Negative Cocci* *

	Dextrose	Levulose	Galactose	Maltose	Lactose	Saccharose	Inulin	Mannitol	Dulcitol	
Meningococcus	+	—	—	+	—	—				
Gonococcus	+	—	—	—	—	—	—	—	—	
Micrococcus catarrhalis	—	—	—	—	—	—	—	—	—	
Micrococcus crassus	+	+	+	+	+	+				
Micrococcus pharyngis-siccus	+	+	—	+	—	+	—	—	—	
Micrococcus flavus	+	+	—	+	—	—	—	—	—	(Chromogenic)
Micrococcus perflavus	+	+	—	+	—	+				(Chromogenic)
Micrococcus subflavus	+	—	—	+	—	—				(Chromogenic)

* + means sugar fermented; —, sugar not fermented.

Subsequent cultures on December 17 and 31 showed only Staph. albus.

On the basis of morphology, fermentation tests and agglutination with specific serums, the organism was determined to be a meningococcus. Agglutination with the higher concentrations of antigonococcus serum is not uncommon with the meningococcus and is to be considered as a cross-agglutination common to this group. The gonococcus ferments dextrose but not maltose, which was fermented by this organism. Table 2 shows the fermentation reactions of the gram-negative cocci and is useful in their differentiation.

Unfortunately cultures were not made of the material from the nasopharynx during the acute condition. Such cultures were made six weeks later, however, and were negative for the meningococcus, as were cultures of material from the conjunctival sac. Later questioning revealed no source of contact with a patient with epidemic meningitis. It seems likely that the organism discovered almost a year before was the meningococcus and that it had been present in an avirulent form until the later acute attack. The acute onset with pain and evidence of damage to the corneal epithelium suggests the possibility that some disturbance

of the normal epithelium, perhaps traumatic, precipitated the acute infection, though the picture of purulent conjunctivitis was already definite sixteen hours later.

REVIEW OF THE LITERATURE

It is well known that conjunctivitis not uncommonly develops in cases of epidemic meningitis, usually early in the course of the disease. McKee [1] found thirteen cases of conjunctivitis among seventy-three patients with epidemic meningitis; he stated that Councilman found the condition in ten of one hundred and eleven patients and Davis, in eight of thirty patients. In most of these cases no bacteriologic examination was made. However, in six later cases of epidemic meningitis in which conjunctivitis was found McKee made careful examinations. Positive cultures were obtained in two, while in two others gram-negative diplococci were found in smears, and other organisms in cultures. Later in a seventh [2] and in an eighth case [3] he obtained positive smears and cultures. In some earlier cases, such as those of Fraenkel and Smith, the cultural methods were not such as to make the identification of the meningococcus certain. In the articles of McKee [1] and Verderame [4] the previous cases are reviewed. It must be remembered that conjunctivitis occurring in cases of meningitis may be due to other organisms than the meningococcus, as in Brons' case [5] in which the gram-negative cocci found in smears proved in cultures to be M. catarrhalis.

More important clinically than such cases of conjunctivitis associated with meningitis are cases of conjunctivitis due to the meningococcus in persons not suffering from meningitis. The first authentic case of this nature was reported by Brons from the Axenfeld clinic.[4] The patient, an 11 month old baby, had keratomalacia and conjunctivitis, and both pneumococci and meningococci were found in the secretion, the latter persisting for two weeks. Thomson [6] apparently saw three cases of catarrhal conjunctivitis due to this organism, although the identification was not complete. Verderame [4] observed a case of slight catarrhal conjunctivitis in which smears, cultures and agglutination tests showed the meningococcus. Contact with persons with epidemic meningitis seemed to be excluded by the fact that no cases were known to exist in Freiburg at the time. Verderame discussed the related presence of the meningococcus in the nasopharynx of persons who had come in contact with the disease and in the nasopharynx of those who had not been exposed; he cited the reports of a number of workers who found this organism in a certain proportion of the nonexposed

1. McKee, S. H.: Ophth. Rec. **17**:438, 1908.
2. McKee, S. H.: Ophth. Rec. **18**:304, 1909.
3. McKee, S. H.: Ophthalmoscope **11**:75, 1913.
4. Verderame, F.: Klin. Monatsbl. f. Augenh. **50**:155, 1912.
5. Brons, C., quoted in Axenfeld, Theodor: Bacteriology of the Eye, translated by Angus McNab, London, Baillière, Tindall & Cox, 1908, p. 223.
6. Thomson, E. S.: Tr. Sect. Ophth., A. M. A., 1906, p. 195.

population. Von Herrenschwand [7] stated that persons exposed to epidemic meningitis but not contracting it may carry the organism in the conjunctival sac as well as in the nasopharynx for as long as seven months. Some of these carriers show slight conjunctival hyperemia and secretion. He cited no personal cases or details of the investigations on which his opinion is based. McKee,[1] in a series of cultures from the normal conjunctiva, positively identified the meningococcus in one case. Its isolation by Lutz [8] from the conjunctiva of a patient with phlyctenosis may be placed in this class of accidental findings.

The other member of the group of gram-negative diplococci which occasionally causes conjunctivitis is M. catarrhalis. In 1915, Blue [9] reported finding this organism in a case of mild conjunctivitis and gave a good review of the subject. Identification was complete, as none of the sugars were fermented. Morax [10] reported two cases in which positive cultures were obtained. One of us has seen a case in which the condition resembled acute pneumococcic conjunctivitis in every respect but in which gram-negative diplococci were numerous in smears. Since these grew freely on plain agar and formed no pigment, the organism was considered as in all probability M. catarrhalis, though no fermentation tests were made.

Muto [11] reported finding another member of this group, M. albicans-amplus, in 75 per cent of a group of patients infected in a swimming pool and also in the water of the pool. From the abstract available it is not evident whether these persons showed the typical picture of swimming pool conjunctivitis, in which case the significance of Muto's findings would be doubtful.

The practical deductions from a review of the subject have been well stated by Blue and may be quoted in conclusion:

1. A purulent conjunctivitis, the smears from which show Gram-negative diplococci, morphologically and clinically resembling the gonococcus, should be treated as gonorrheal ophthalmia. In the presence of a urethral discharge or definite history of infection a definite diagnosis of gonorrheal ophthalmia should be made.

2. A purulent conjunctivitis, in a person nursing a case of epidemic meningtis or giving a history of possible recent exposure to infection by the meningococcus, the smears from which show Gram-negative diplococci, should be treated as a gonorrheal ophthalmia, but the diagnosis withheld until substantiated by cultures.

3. A mild conjunctivitis, the smears from which show Gram-negative diplococci, should be treated as conjunctivitis in general is treated; cultural and laboratory procedures should be at once initiated to establish a definite diagnosis.

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7. von Herrenschwand, F.: Die pathogenen Mikroorganismen des Auges, Berlin, Urban & Schwarzenberg, 1927, p. 139.

8. Lutz: Klin. Monatsbl. f. Augenh. **48**:636, 1910.

9. Blue, R.: Arch. Ophth. **44**:652, 1915.

10. Morax, V.: Ann. d'ocul. **161**:401, 1924.

11. Muto, N.: Acta soc. ophth. jap., 1930; abstr., Zentralbl. f. d. ges. Ophth. **24**:405, 1931.

THE APPLICABILITY OF THE KRÖNLEIN OPERATION FOR THE REMOVAL OF CYSTICERCUS OF THE POSTERIOR HALF OF THE EYE

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When the question of therapy of cysticercosis of the eye is considered, only the operative treatment should be accepted, since the other methods (killing of the parasite, treatment with Filix mas, the use of potassium iodide, neoarsphenamine and benzene, injections of corrosive mercuric chloride, electrolysis and treatment with radium) are seldom successful. Unfortunately, the success of operation is still doubtful, the incidence of failures generally amounting to from 30 to 40 per cent. This percentage would be considerably higher if one counted as failures the complicated, though finally successful, extractions accomplished by repeated introduction of traction instruments with a large loss of vitreous. My associates and I consider the operation successful if the cyst delivers itself, or falls out, after a small incision has been made and the edges of the scleral wound have been pulled apart. Dupuy-Dutemps,[1] Smolianinov,[2] Plasbinin,[3] Lotin[4] and Bursak[5] advocated interrupting and postponing the operation in case the cyst does not fall out immediately after the incision. This is justified by the fact that after the postponement a second incision usually leads to good results. The difficulty of operating for a fixed cysticercus is due mainly to the difficulty in locating it. The usual method of calculation of Alfred Graefe, Hirschberg, Dupuy-Dutemps and Polliak stresses the importance of the determination of the distance of the cyst from the limbus of the cornea. In the reports of such cases as I could collect from the literature in which the cysticercus was extracted with good results, the authors have expressed considerably different opinions concerning both the beginning and the length of the incision, even in cases in which the parasites were in obviously similar positions. For a cysticercus cyst behind the ora

1. Dupuy-Dutemps: Cysticerque sous-rétinien; extraction, Ann. d'ocul. **144**: 305, 1910.

2. Smolianinov: Vestnik oftal. **34**:1, 1917.

3. Plasbinin: Russk. oftal. j., 1923, vol. 3.

4. Lotin, A. W.: Zentralbl. f. d. ges. Ophth. **20**:814, 1928.

5. Bursak: Russk. oftal. j. **4**:530, 1925.

serrata Leber [6] starts the anterior end of the incision 4 mm. behind the limbus, and Treitel,[7] 6 mm. behind it. For a cyst in the vicinity of the equator, Auerbach [8] started the incision 12 mm. behind the limbus and Krukow,[9] 7 mm. According to Kraemer,[10] an incision of about 9 mm. in length, starting from 4 to 5 mm. behind the limbus, is large enough to reach and remove the parasite under all circumstances. For a cysticercus cyst behind the equator, Wossjubinsky [11] and Katznelson [12] started the incision 8 mm. behind the limbus; on the other hand, if the cyst is situated near the posterior pole of the eye, Prokopenko started the incision 11 mm. behind the limbus; Bardelli,[12a] 13 mm.; Odinzow, 20 mm., and Dupuy-Dutemps, 23.5 mm. The length of the incision varies just as much. The shortest incision which sufficed to remove a cysticercus cyst is reported as having been the size of a pinhead (Smolianinov [2]). Odinzow, Pillat,[13] Loginoff [14] and Thierry [15] made an incision of from 3 to 4 mm. in length; Melanowski,[16] of 8 mm., and Chermak,[17] Wassjubinsky and Lazaroff,[18] of 12.5 mm. If we accept our experience that the cysticercus cyst can be delivered through an incision which touches only the anterior pole of the cyst, an incision of from 12 to 13 mm. is sufficient for the delivery of any cyst situated in an area of about half the arc between the macula and the limbus.

Considering the variety of the site and the length of the incision, one can easily understand that an exact examination with the perimeter is not necessary; a simple examination with the ophthalmoscope is sufficient to determine approximately the point where the incision is to start. Furthermore, it is understandable that some authors (Treitel,[19] Strachow and Filatow) do not care much for exact measurement. Treitel, Filatow and also Sattler advocated making the incision in a place that is convenient for the introduction of the instruments, no matter where the cyst is situated. If the operation is not successful, the

6. Leber, cited by Kraemer.[10]
7. Treitel, cited by Kraemer.[10]
8. Auerbach: Vestnik oftal. **34**: 1917, nos. 2 and 3.
9. Krukow, A.: Vestnik oftal. **23**:265, 1907.
10. Kraemer: Die tierischen Schmarotzer des Auges, in Graefe-Saemisch: Handbuch der gesamten Augenheilkunde, ed. 2, Leipzig, W. Engelmann, 1889-1900.
11. Wossjubinsky: Russk. oftal. j. **5**:850, 1926.
12. Katznelson: Russk. oftal. j. **4**:278, 1925.
12a. Bardelli: Zentralbl. f. d. ges. Ophth. **8**:364, 1917.
13. Pillat, A.: Zentralbl. f. d. ges. Ophth. **4**:325, 1915.
14. Loginoff: Sovet. vestnik oftal. **2**:5, 1933.
15. Thierry: Zentralbl. f. d. ges. Ophth. **20**:75, 1928.
16. Melanowski, W. H.: Klin. Monatsbl. f. Augenh. **81**:273, 1929.
17. Chermak: Centralbl. f. prakt. Augenh. **21**:288, 1897.
18. Lazaroff: Vestnik oftal. **29**:689, 1913.
19. Treitel, T.: Arch. f. Augenh. **21**:270, 1889-1890.

failure is not caused by the length of the incision or its distance from the limbus. Moreover, the surgeon can easily enlarge the incision, if necessary, during the operation.

Much simpler than the determination of the distance from the limbus is the determination of the meridian. It is determined approximately with the perimeter and then transferred to the eye. "It seems to be useful, after cocainizing the eye and inserting the speculum, to put on as exactly as possible a trial frame with axis scale (or still better a similar smaller instrument), and mark at least the corresponding point of the limbus or the beginning of the meridian line with India ink." [20] The exact determination of the meridian is much more important than the measurement of the distance from the limbus, because in case of an error in the measurement of the distance the incision is simply prolonged if necessary, but if the incision has been made in the wrong meridian it is necessary to enlarge the incision in the form of a scleral flap, which, of course, should be avoided. In order to ascertain the site of the cysticercus, Gallemaerts [21] put a concave glass plate on the cornea and filled the space between the plate and the cornea with sterilized serum. Elschnig [22] used Köppe's contact glass for the examination of a cysticercus cyst in the eyeground. The same contact glass may be used for examination under illumination from the side. If the eyeground is illuminated through the contact glass with the illuminating rod of Simon's mirror, one can see the cyst in an upright position very distinctly with the naked eye. If a well made trial frame is put in place, so that the visual axis goes through the center of the contact glass and through the middle of the trial frame, it is easy, with the help of a thin rod put on the frame, to determine the exact meridian which goes through the middle of the cysticercus cyst. To transfer the amount onto the eye, I use a flat ring with a graduated edge the opening of which has a diameter of 12 mm. The ring is put on the anterior surface of the eye and kept in this position with a short pin which is fixed on the middle of two wire arcs which cross the ring. The meridian is then marked on two opposite points of the limbus with a silk thread—the usual Gonin method. The difficulty of finding the exact meridian induced me to make the incision somewhat obliquely instead of meridionally, so that it touched several meridians which differ from 10 to 20 degrees.

The operation for a subretinal cysticercus around the posterior pole of the eye seems to be much easier than for one in the vicinity of the

20. Lenz, G., in Elschnig, A.: Augenärztliche Operationslehre, Berlin, Julius Springer, 1922, p. 1368.

21. Gallemaerts: Arch. d'ophth. **32**:137, 1912.

22. Elschnig, A.: Klin. Monatsbl. f. Augenh. **75**:130, 1925.

equator for the following reason: The determination of the distance of the parasite from the disk in papilla diameters is very simple and much more correct by the method of Schmidt-Rimpler than by the perimeter method of A. Graefe. If one uses direct ophthalmoscopy—which is absolutely necessary—the error cannot be more than from ½ to 1 papilla diameter. That means a difference in the length of the incision of from 0.75 to 1.5 mm., which is unimportant for the result of the operation. It is just as easy to determine the meridian near the posterior pole. Furthermore, if one considers that the nearer the posterior pole the smaller the distance between the meridians and that a cyst near the posterior pole leans onto the wall of the eyeball with a relatively much larger flat surface than the same cyst does near the equator, it should be realized that it is much easier to make the correct incision for extraction of a cysticercus near the posterior pole than for one at some other location. However, the following rules must not be overlooked: First, the optic nerve should be reached easily so that the required distance of the incision can be measured and the instruments easily handled. Second, the bulbus must not be pulled too far anteriorly or laterally, for strong pulling or turning of the eyeball leads to a great loss of vitreous, the gaping of the wound is inhibited and, consequently, the delivery of the parasite is more difficult.

Both requirements can be fulfilled only by Krönlein's temporary resection of the temporal orbital wall; this is the only operation which permits easy access to the posterior pole and the optic nerve. The open field of operation reached by Krönlein's method gives a clear inspection, which makes it possible to avoid forced traction of the bulbus to one side with the sutures through the stump of the muscle. In general, the Krönlein operation does not do any harm, and we prefer it to other methods. However, we can get along occasionally without the Krönlein operation, e. g., in cases in which the eyes are highly prominent. That this is not an easy way is demonstrated by the publications of several authors who used other methods. For instance, Krukow [23] said that he could not reach the posterior pole in spite of grasping the optic nerve with a muscle hook and pulling it forward. In cases of cysticercosis in the macular area, when the vision is practically lost, Lewitsky [24] recommended severing the optic nerve in order to obtain an easier delivery and turning the posterior pole of the eyeball forward. Zirm [25] used this method before Lewitsky. Silva [26] expressed the belief that a cysticercus cyst can be removed from the macular region

23. Krukow: Vestnik oftal. **24**:405, 1908.
24. Lewitsky: Russk. oftal. j. **5**:825, 1926.
25. Zirm, E.: Centralbl. f. prakt. Augenh. **14**:27, 1890.
26. Silva, Rafael: Am. J. Ophth. **11**:875, 1928.

without the Krönlein operation, but in describing a case he said that if the patient were a man and not a woman he would recommend evisceration of the eyeball.

The following cases demonstrate the advantages of the Krönlein operation for removing cysticercus cysts from the posterior pole of the eye.

REPORT OF CASES

CASE 1.—R. B., aged 35, entered the hospital on April 15, 1929. The patient first noticed dimness of vision in the right eye three months before admission. A physician prescribed some medicine and mercurial ointment. No improvement took place. The "fog" in front of the eye became worse, but otherwise the patient felt well. According to the past history, he had had pneumonia and typhoid. He said that he often ate raw pork.

The right eye was normal externally and the media were clear. Ophthalmoscopy showed a greenish silver-white cyst, which was almost round though somewhat flattened nasally, ⅓ papilla diameter from the temporal margin of the disk. The cyst was from 5 to 6 papilla diameters in diameter. The outline of its lower portion was distinct and lay ½ papilla diameter lower than the disk; the temporal portion was also distinctly outlined. The upper end gradually became flattened and was continued by a shallow detachment of the retina. The retinal vessels went over the cyst, the upper temporal vein being considerably enlarged. At the beginning of the flat detachment of the retina, wavelike motions were visible. The head of the parasite changed position too. It was visible in the middle of the cyst as a round, greenish-white body.

April 30: On the upper, flattened part of the cyst appeared a double line. The anterior line belonged to the detached retina and was visible with +3.00 diopters. The upper end of the ablatio retinae lay about 4 papilla diameters above the disk. The posterior line corresponded to the upper border of the cyst, which accounted for the globe-shaped form. The lower exterior border was the most prominent and was seen with +8.00 diopters.

Vision in the right eye was 1/200 and in the left eye, 1, 0.

The visual field showed a central scotoma extending 6 degrees upward, 35 degrees downward, 10 degrees temporally and 20 degrees nasally.

The blood count showed 5 per cent eosinophils. The Wassermann reaction was negative. Examination of the feces showed Ascaris lumbricoides and Trichiuris.

Operation was performed with the patient under local anesthesia. A temporary resection was done according to the Krönlein technic. Typical incisions of the skin and bone were carried out. The tendon of the external rectus muscle was severed after being supplied with two pairs of catgut sutures. The sclera was freed as far as the optic nerve. Layers of the sclera were gradually cut with a Graefe knife 3 mm. temporally of the disk and at the level of the upper edge of the disk. The length of the incision was from 6 to 7 mm. The edges of the sclera were separated with two sharp hooks. As the cyst did not present itself, the incision was enlarged somewhat with scissors. After the edges were pulled apart a little more, the cyst came out of the wound, and some vitreous followed. The sutures of the external rectus muscle were tied together. Catgut sutures were used for the periosteum and skin sutures to close the wound.

May 9: Vision in the left eye was 7-8/200. Lateral movements were inhibited and there was slight edema but no exophthalmos. The disk was well visible, but

somewhat cloudy. The ablatio retinae was subsiding and measured horizontally from 2 to 3 papilla diameters and vertically from 5 to 6 papilla diameters. Corresponding to the incision near the lower end of the detachment in the level of the upper border of the disk there was a hemorrhage and behind it a wide split of the choroid.

CASE 2.—Maximenko entered the hospital on Feb. 8, 1929, with the history that he never ate raw pork but sometimes ate raw lard. The patient noticed a sudden pain above the left eyebrow about ten days before admission, and on covering the right eye he realized that he could not see with the left one.

July 8: Ophthalmoscopy showed the disk well visible. A nearly round, gray elevation covered with retinal vessels was seen from ⅓ to 2 papilla diameters laterally from the disk. In the center of the cyst the whitish head of the parasite was visible situated at the level of the disk and about 4 papilla diameters laterally from it. Movements both of the cyst and of the head were distinctly visible.

July 19: The cyst was increased in size and had moved upward and somewhat outward. It measured horizontally and vertically from 5½ to 6 papilla diameters. The upper edge was sharply outlined and lay 3 papilla diameters above the upper border of the disk. Below and nasally it went over gradually into a shallow detachment of the retina. This detachment enlarged under the disk to from 2½ to 3 papilla diameters and corresponded obviously to the former site of the parasite. The head lay from 5 to 6 papilla diameters temporally and from ½ to 1 papilla diameter above the disk.

The visual field showed a central scotoma extending 20 degrees temporally and 10 degrees nasally.

Examination of the feces showed Ascaris lumbricoides (numerous) and Trichiuris (very few).

Krönlein's operation with Gonin's modification was performed under local anesthesia. The periosteum was not separated from the bone. The external rectus muscle was freed and severed between two pairs of catgut sutures. The sclera was freed up to the entrance of the optic nerve. A point 6 mm. laterally from and 1 mm. above the disk was determined, and an incision of from 8 to 10 mm. in length was made through the sclera with a Graefe knife. The incision was made slightly obliquely from behind above, forward and downward. The edges were pulled apart with small, sharp hooks. The gray cyst was visible in the wound. When the edges were gently pulled apart somewhat more, a small amount of vitreous came out, and immediately the cyst followed. The catgut sutures were tied together. The conjunctival, periosteum and skin sutures were tied.

July 28: The detachment of the retina was considerably flattened, especially in the inner upper part, and could be seen with +4.00 diopters. Corresponding to the incision there was a long, wide hemorrhage, which formed the upper border of the detachment. The hemorrhage lay 1 papilla diameter over the level of the disk and measured laterally from 3 to 4 papilla diameters. It seems that an injured blood vessel extended into the hemorrhagic area.

Vision in the right eye was 1, 0; in the left eye, 4/200.

CASE 3.—Averjanowa A. in the middle of May 1932 noticed a "fog" in front of the right eye, floating black spots and considerable diminution of the visual acuity. The patient came to the clinic of the hospital on April 29. At that time the following record was made on the chart: Vision in the right eye (?). Near the macula lutea was a cyst from 1½ to 2 papilla diameters in diameter, in the middle of which was a round white point (head of Cysticercus?). The Wassermann reaction was negative.

July 13: Temporally, below the disk there was an oval gray cyst covered with retinal vessels, which lay in an oblique position so that the longer, more vertical diameter—approximately from 3 to 3½ papilla diameters long—reached the level of the disk with its upper inner end. This end lay about 1 papilla diameter from the disk. The lower temporal pole of the cyst was situated about 3 papilla diameters below the disk. The anterior surface was distinctly visible with —7.00 diopters. The head of the cysticercus was seen as a whitish, sharply outlined point in the center of the cyst. The upper part of the cyst—at the level of the disk—was continued by a flat detachment of the retina. This detachment was round, less than 1 papilla diameter in size and visible with +3.00 diopters. The center was darker and somewhat depressed and surrounded by net-shaped folds. Probably this was the original site of the cyst. Vision in the right eye was 1-2/200 and in the left eye, 1, 0. There was a central scotoma extending 18 degrees upward and 8 degrees downward.

The blood count showed 5 per cent eosinophils.

Examination of the feces revealed Ascaris lumbricoides.

July 20: The cyst was somewhat larger and slightly turned so that the larger diameter was in an almost vertical direction. The upper pole of the cyst lay at the level of the disk. Here, on the upper pole, the movements of the parasite were best visible. Furthermore, the cyst sank deeper; consequently the empty part of the detachment became enlarged; its upper tapering end blended with the aforementioned focus.

July 25: The cyst had become still larger. The longer diameter measured from 5 to 6 papilla diameters, and the shorter one from 4 to 5 papilla diameters. The distance from the disk was 2 papilla diameters. The longer diameter was directed between 7 and 8 o'clock. The lower temporal vein, the blood circulation in which was clearly visible, crossed the cyst in the same direction.

July 26: Operation was performed under local anesthesia. Krönlein's temporary resection of the bone and typical incisions of the bone were carried out. It was difficult to find the external rectus muscle. Its tendon was severed between two pairs of catgut sutures. The sclera was freed from the surrounding tissue. The incision through the sclera was made about 3 mm. lateral to the optic nerve, from 5 to 6 mm. long and slightly oblique in the direction between 7 and 8 o'clock. The edges were gently separated; some subretinal fluid appeared, and immediately afterward the cyst fell out. The muscle sutures were tied, and the periosteum was sutured with catgut. Five skin sutures were used.

July 30: There was slight edema of the upper lid and of the conjunctiva in the lateral part. The movements of the eye were possible only in the nasal direction. The edema disappeared later; the lid opening was normal. Normal movement came back, only lateral movement being slightly inhibited. The pupil reacted normally.

July 5: Ophthalmoscopy (direct method) showed a flat detachment of the retina at the site of the cysticercus. In the lower part, corresponding to the incision of the sclera, there was a slit-shaped groove, at a distance of about 1½ papilla diameters from the disk, and extending from inside above, outward below. The retinal vessels descended into the groove and showed sharp angles where they crossed the edges of the groove. On the bottom of the depression there were vitreous opacities with point-shaped hemorrhages. The detachment was more marked above the incision and tapered to a hook-shaped fold between the macula and the disk. Nasally from the detachment, below the disk, were several hemorrhages, arranged in a vertical line.

August 2: Vision in the right eye was 4/50 and in the left eye, 1, 0.

COMMENT

As far as the Krönlein resection was concerned, the wounds were sutured in all three cases, and the healing was normal.

The diagnosis was easy in all the cases. The characteristics of the cyst, its position behind the detached retina and its movements confirmed the diagnosis. In all three cases the migration of the parasite could be followed; in the first two cases it was downward and in the third case, upward. The emptied part of the detachment became flatter, and in this place the movements of the cyst were best visible. Of course, there was no real migration of the cyst as a whole from one place to another under the detached retina. On the contrary, the progressive pole of the cyst stretched the detached retina tightly and made it bulge downward in the first two cases and upward in the third case. The opposite free part of the detachment showed most markedly the movements of the subretinal fluid. This point is perhaps of importance in considering where the incision should be made. Should one make the incision over the cyst or over the empty space? In the latter case the incision is opposite the direction of the movement of the parasite. For the delivery of the cyst, the increased intra-ocular pressure is the main propelling power. However, the direction of motion of the parasite must be taken into consideration. Furthermore, if the incision is made cautiously, injury of the wall of the cyst is practically impossible.

A correct incision was made only in the third case. It did not cut the retina. A. Graefe [27] mentioned that only subretinal fluid but no vitreous should be lost while removing a subretinal cysticercus; vitreous is lost only when the retina is injured by the incision. In the third case no vitreous appeared but only a small amount of yellowish subretinal fluid. That the retina was not cut is proved also by the fact that it reattached itself to the groove in the choroid which corresponded to the scleral incision and formed a depression where the descending retinal vessels showed sharp angles. The small hemorrhages arranged in a line inward from the detachment and the blood points in the vitreous were probably due to acute stretching and not to an injury of the retina during the incision. Loss of vitreous occurred in the first two cases, though in a small amount. In the second case the incision was too long and situated too far laterally.

Where the retina was cut in the first case is difficult to say, for according to the calculation and the ophthalmoscopic findings after the operation the incision probably was in the area of the detachment. In all cases there was considerable reattachment of the retina after a short time.

27. Graefe, Alfred: Centralbl. f. prakt. Augenh. **16**:362, 1892.

In the third case the reattachment started in the middle of the detached area, and in the first and second cases in that part of the retina which became detached first and not in that part which corresponded to the empty space of the ablatio retinae.

It is known that following ignipuncture with healing of a spontaneous detachment of the retina near the macula, normal or almost normal function returns; the same result occurs following operation for Cysticercus even after a detachment which lasted a long time. Since scleral incisions near the posterior pole can cause a direct or indirect injury to the macula, a slightly oblique incision is recommended, the region of the macula being avoided.

ECTOPIA LENTIS

REPORT OF TWENTY-TWO CASES IN FIVE SUCCESSIVE GENERATIONS

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Ectopia lentis is a congenital, and ordinarily a bilateral and symmetrical, displacement of the crystalline lens, and from the number of reports in the literature it is of comparatively rare occurrence. Knapp [1] observed that it occurred approximately once in five thousand cases. Zentmayer [2] stated that the case presented by Horner and Maisler [3] before the Section on Ophthalmology of the American Medical Association in 1933 was the first brought before that body since 1898. Von Graefe,[4] in 1854, was the first to record this condition in the literature. Several investigators have written of the striking hereditary tendency of the disease. Folk [5] quoted Adams as reporting seven cases in one family of nine members. Cameron [6] reported that in four successive generations the condition involved fourteen persons, only one of whom was a male. Kennedy [7] reported a case in a family showing a decided hereditary tendency to the disease, and Lewis [8] described sixteen cases occurring in six generations of one family. Morton [9] recorded its occurrence in ten persons from five successive generations. Knobloch [10] described twenty-six cases, in all of which the condition was bilateral and was found in highly myopic eyes. As cited by Zentmayer, R. M. Gunn recorded its occurrence in seventeen members of five families with a total of twenty-two children, in whom the hereditary tendency acted as a pure mendelian dominant characteristic. Francheschetti's case was

1. Knapp, quoted by Lang and Collins, in Norris, W. F., and Oliver, C. A.: System of Diseases of the Eye, Philadelphia, J. B. Lippincott Company, 1897, vol. 1, p. 450.

2. Zentmayer, William, in discussion on Horner and Maisler.[3]

3. Horner, W. D., and Maisler, S.: Ectopia Lentis with Report of a Case of Total Dislocation, Directly Downward, J. A. M. A. **101**:1302 (Oct. 21) 1933.

4. von Graefe: Arch. f. Ophth. **1**:345, 1854; **2**:250, 1855.

5. Folk, M. L.: Ectopia Lentis: Report of Three Cases, Illinois M. J. **47**:314, 1925.

6. Cameron, E. P.: An Interesting Example of Hereditary Dislocation of the Lens Occurring in Four Successive Generations, Brit. J. Ophth. **10**:384, 1926.

7. Kennedy, E. W.: Complete Ectopia Lentis; Report of Case, New York State J. Med. **25**:117, 1925.

8. Lewis: Arch. Ophth. **33**:275, 1904.

9. Morton: Ophth. Hosp. Rep., London **9**:435, 1879.

10. Knobloch, R.: Luxation of the Lens, Casop lék. česk. **70**:1364, 1931.

one of a recessive hereditary condition, while Kotlarveskaid's thirteen cases were considered by him as of the dominant hereditary type.

The chief characteristics of ectopia lentis as described in the literature are myopia, corectopia, iridodonesis with nystagmus and symmetrical bilateral displacement. Although some authorities, as cited by Horner and Maisler, have not accepted the statistical evidence that there are cases of displacement directly downward, there are in addition to the case which Horner and Maisler reported, five cases described by Dorsch [11] occurring among a total of seventy-three which he studied. R. M. Armstrong told me that he has seen one case of bilateral displacement directly downward. Among the seventy-three cases reported by Dorsch, there were also three cases of asymmetrical arrangement. Page [12] described one case of unilateral ectopia lentis. Crebbin [13] reported a case of asymmetrical ectopia lentis with persistent pupillary membrane.

Hegner [14] reported a case in a patient, aged 28, without disturbance of vision. As to the causative factor in this condition, Hegner stated from the study of his cases that defects of the zonular fibers do not always play an obvious rôle. His report showed that, although the zonular fibers are not always absent, there is a lack of uniformity in their development which produces an uneven stress, while at times there is an absence of zonular fibers. Traction of the hyaloid artery and bands in the vitreous have been suggested as possible causative factors. Badel and Lagrange, as cited by Horner and Maisler, expressed the belief that all the eyes showing this condition are myopic and that the lens is too small, thereby producing an undue stretching of the zonular fibers, which yield, causing displacement of the lens in the direction of least resistance. Against this theory Lindner, cited in the same paper, reported four cases in which the lens was larger than normal.

There are various suggestions in regard to treatment. Corrective measures devolve into two classes, viz., refraction and surgical treatment. Varied success has been reported. Zentmayer recorded a case in which extraction of the lens in one eye was followed by visual acuity of 6/20. As a result of his success, the other eye was similarly operated on, but it was lost owing to iridocyclitis resulting in atrophy of the globe. Of the eight cases recorded by Knobloch in which the lens was extracted there was a definite improvement of vision in six. Most

11. Dorsch, Nathaniel: Ueber angeborene und erworbene Linsenluxation und ihre Behandlung, Marburg, J. Hamel, 1900.

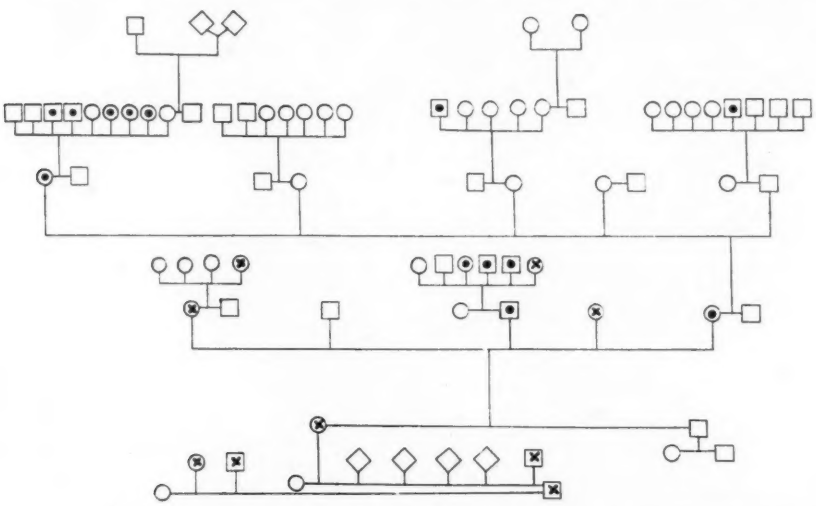
12. Page: Lancet **2**:193, 1874.

13. Crebbin, A. R.: Persistent Pupillary Membrane and Congenital Ectopia Lentis, Am. J. Ophth. **12**:87, 1929.

14. Hegner, C. A.. Bemerkungen ueber das Verhalten der Zonulafasern bei der Ectopia lentis, Klin. Monatsbl. f. Augenh. **55**:22, 1915.

authorities have suggested discission. Fuchs [15] suggested correcting with glasses either the phakic or the aphakic portion of the pupil, whichever is the more amenable.

My series of cases is taken from five successive generations of one white family, comprising seventy-eight persons of whom twenty-two were affected. Ten cases occurred in males and twelve in females. The youngest patient was 5 years old and the oldest 69. The sixth generation was represented by a pair of biovular twin boys, aged 4 years, and a boy aged 1 month. The eyes of these three children were apparently normal. Mydriasis was employed in examination of the twins because of my zeal to report the occurrence of the condition in the sixth successive generation. If mydriasis had been employed in the



Occurrence of ectopia lentis in twenty-two members of six generations of one family. In the chart, hollow squares indicate males; hollow circles, females; solid circles, persons examined personally, and crosses, persons whose condition was vouched for by a member of the family.

examination of each patient, it is possible that more cases could have been recorded. Because of the difficulty in locating and examining these persons, mydriasis was impracticable, and in some instances permission was refused.

Of the twenty-two patients, I saw thirteen personally. The cases of the remaining nine were vouched for by members of the family who had previously given correctly the histories of the thirteen members. On a statement from one member of the family that another had "bad eyes," investigation would reveal the condition of ectopia lentis. On the

15. Fuchs, E.: Text-Book of Ophthalmology, translated by A. Duane, ed. 8, Philadelphia, J. B. Lippincott Company, 1924, p. 649.

strength of these statements, the data on the first and second generations given in the accompanying chart were supplied.

As the families were scattered throughout three counties, physicians who are rural practitioners can appreciate the difficulty and disorganization attending these examinations on Sundays and at odd moments over the period of a year.

The members of the families are of good general mentality, although most of them have had a meager education. There is no consanguinity, and the group as a whole can be classified as having good general health.

Poor vision was the chief subjective symptom, while iridodonesis with nystagmus was the most common objective symptom. Myopia was the rule. No corectopia or aniridia was noted in any patient in the series. It seems that as the age increased there was also an increase in the opacity of the lens and in iridodonesis. One of the twins, aged 4, of the sixth generation presented nystagmus, but none of the other objective or subjective symptoms. If possible, it will be interesting to note the condition of the eyes of these boys in later years.

The following four cases are representative of the entire group:

CASE 1.—In a boy aged 12, who had always complained of poor vision, examination revealed a bilateral, symmetrical displacement of the lens upward and outward. The lens covered about one half of the pupillary area in each eye. With reflected light the phakic area was grayish and presented the crescentic edge of the clear lens. The aphakic area was black. There was coarse lateral nystagmus. The pupils were round and equal and reacted to light and in accommodation. Iridodonesis was marked in each eye. Examination of the fundus gave negative results. The visual acuity in each eye was 8/200. An attempt to improve visual acuity through lenses for either the phakic or the aphakic portion was only moderately successful.

CASE 2.—A woman aged 60 had had "bad eyes" during her entire life, and for the past twenty-five or thirty years she had been blind in the right eye. The lens was displaced upward and outward and was opaque. No satisfactory examination of the fundus was possible. The left eye presented a shrunken, opaque lens which floated free across the pupil, the direction depending on the position of the head. The pupil was round and reacted to light. Iridodonesis was marked in each eye, but there was no nystagmus. The visual acuity was 6/100 and could not be improved with lenses. There was no history of disease or trauma.

CASE 3.—A man aged 69, a brother of the patient in case 2, had had "bad eyes" during his entire life. Examination revealed that both lenses were diminished in size, opaque and free to float across the pupil in any direction. The pupils were round and equal and reacted to light and in accommodation. There was no nystagmus, but iridodonesis was marked. A +10.00 sph. for each eye gave serviceable visual acuity of which the patient did not complain. There was no history of disease or trauma.

CASE 4.—The case of a girl aged 15 is worthy of mention. She had had "bad eyes" all her life. The dislocation of the lens was upward and outward. The right eye disclosed a partially opaque lens while the left eye was clear. Visual acuity was 8/200 in each eye and could not be corrected with lenses. The pupils were round and equal and reacted to light and in accommodation. There was no

nystagmus, but iridodonesis was marked. The disk in each eye appeared from about one-third to one-half the normal size, although the position of the vessels was normal. The retinas and maculae were normal. This was the only patient of the thirteen who showed diminution in the size of the nerve head. When the patient was 6 years old a discission was done on the right eye, and because there was no immediate improvement no further operation was permitted. The mother stated: "Providence has willed 'bad eyes' on me and my family, and we will be content with our condition." Incidentally, the mother and five of her nine children were affected. Four of these children are now inmates of the Kentucky School for the Blind.

SUMMARY

The vision of only two of the thirteen patients was improved by lenses. Discission was permitted in one instance, but without success. From the accompanying chart it is obvious that heredity has played an all-important rôle.

Clinical Notes

A SHORT-STOP BIDENT ELECTRODE FOR DIATHERMIC TREATMENT OF SEPARATED RETINA

Designed for Rapid Performance with Minimal Loss of Fluid

CLIFFORD B. WALKER, M.D., LOS ANGELES

Recently in the ARCHIVES OF OPHTHALMOLOGY, Dr. Mark J. Schoenberg [1] described a two hook diathermic cutting current electrode for the treatment of separated retina. This at first glance was so similar to my double-pronged short-stop electrode which was exhibited at the September meeting of the Academy of Ophthalmology and Otolaryngology while Dr. Schoenberg was traveling in Europe that it seems worth mentioning. I did not know of any other work on a similar device until the aforementioned article was published.

My device, shown in the accompanying photograph, differs in several details. The prongs are 2 mm. apart but can be bent to 2.5 mm. or 3 mm. apart. Each prong has a step-stop, filed in, so that it will not penetrate far enough under 100 milliamperes of diathermic current to permit the supporting arms to touch the sclera, thus reducing scleral damage and alteration of the current to a minimum. The length of the penetrating points from the stop is only 0.5 mm. for the thin sclera, particularly under muscles, and 0.7 mm. for thicker sclera. The object of these lengths is to cauterize the choroid without having leakage of fluid. I am very much against permitting the slightest leakage until the end of the operation. But even these short-stop prongs occasionally give a little leakage; therefore, I do not recommend them for the primary barrage line but only for the secondary barrage line and for stippling the remaining enclosed area. The best results are gained when no softening of the eye and consequently no retinal damage are permitted.

It follows, then, that I do not recommend such hooks as retractors, because I have noted that their use permits leakage beside the prongs and may by pulling on the choroid break the coagulum in such a way as to cause bleeding. Then, again, it would require two handles and two active electrodes to produce any real advantage in such retraction.

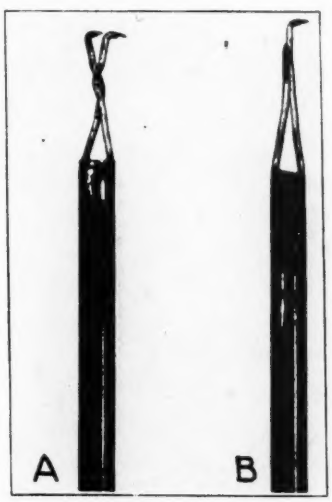
With regard to depth, these bare electrodes give trouble in a field that cannot be kept dry and in one of insufficient size to give air insulation of the bare wires. The farther back they are used the greater the risk becomes of making new retinal holes when fluid is lost. This is because the current is active at the short points of the electrode and does damage from 0.5 to 1 mm. beyond the points. It is often possible to go within 10 mm. of the macula on the temporal side but not much beyond the zone of the venae vorticosae elsewhere without risk of damage to the

1. Schoenberg, Mark J.: An Electrode Which Simplifies the Technic of Electrosurgical Treatment of Retinal Detachment, Arch. Ophth. **13**:252 (Feb.) 1935.

venae by traction. Other methods, principally Lindner's undermining procedure, must be used in treating still farther back, especially at the macula.

The wire (0.4 mm. diameter of 15 per cent iridium-platinum) is so twisted and soldered with platinum as to give rigidity. It is not curved because it does not seem advisable to use the tips out of sight. Flexibility leads to lack of control in penetration.

It is true that the fluid leak from hook punctures is slow and must constantly be mopped away to maintain a dry field. It therefore seems small in amount, but hydrostatically it rapidly causes a soft eye. Even retraction draws the sclera and choroid so close to the retina that even with the low pressure of the cutting current conditions are right for the production of new retinal holes, which are especially undesirable in the outer barrage line zone.



Short-stop double and single prong diathermic electrodes. *A* illustrates a bident electrode with the prong end twisted at right angles to the hilt in order to give increased rigidity and projecting far enough from the holder so that it may be heated to redness in the alcohol lamp without injury to the holder. *B* illustrates a single point short-stop electrode for landmarking and for use in spaces too small for the bident.

If limited to only one electrode I should choose a short-stop bident because it has the least tendency to soften the eye by leakage, but I should feel most decidedly handicapped to be thus limited, especially in treating shallow detachments on the area near the edge of a bullous area or in any extensive, time-consuming operation, for example, when multiple distributed retinal tears are present. Therefore it seems to be a valuable accessory only, since it is impossible consistently to treat down to the choroid without sometimes, in the early stages, obtaining a regrettable loss of fluid.

B in the figure shows the same principle applied to a single prong. The single prong can be used to advantage in spaces too small for use of the bident and also if very lightly pressed, as a marker to lay out

the principal zoning points of the barrage line. The platinum portion of these devices is firmly crimped and hard soldered into the standard size of male member to fit practically any chuck handle.

These devices are made by the United States Optical Company, 671 South Anderson Street, Los Angeles.

A SIMPLE INSTRUMENT FOR CURETTING THE RUST FROM THE BED OF A CORNEAL FOREIGN BODY

J. H. Hulka, M.D., Long Island City, N. Y.

A particle of iron embedded in the cornea often produces a deposit of rust which tattoos the trabeculae of the cornea and Bowman's membrane and is usually difficult to remove. Attempts to remove it by curetting with corneal curets or spuds inevitably result in disturbing the surrounding intact epithelium and Bowman's membrane, thus enlarging the original lesion.

It is simple to curet the rust from the bed of a metallic foreign body by using a carbon drill, gage 70 or 60. This drill can be obtained in a hardware store for 10 cents. A few drilling movements with the tool held between the thumb and the index finger, without pressure against the anesthetized cornea, will result in a clean and smooth removal of the rust.

Ophthalmologic Review

EDITED BY DR. FRANCIS HEED ADLER

VASCULAR BASIS OF TOBACCO AMBLYOPIA

TREATMENT WITH NITROSCLERAN

WALTER F. DUGGAN, M.D.

NEW YORK

The clinical picture of tobacco amblyopia has been known for many years. In 1896, de Schweinitz [1] published a comprehensive and scholarly monograph on all types of toxic amblyopia. The discussion of the tobacco-alcohol group occupies almost one half of the volume and includes references to nearly two hundred original articles.

Samelsohn, Nettleship and Edmunds, Vossius, Bunge and Uhthoff had demonstrated earlier a degeneration of the papillomacular bundle as the chief lesion in cases of tobacco-alcohol amblyopia. Among the various theories offered as the cause of this degeneration were the following:[2]

1. That it was due to primary interstitial inflammation of the optic nerve.

2. That it was due to primary involvement of the nervous elements of the nerve and retina, with secondary glial proliferation and increase in connective tissue.

3. That it was due to retrobulbar neuritis.

4. That it was secondary to a lesion in the macular region of the retina.

Treatment in the past included abstinence from tobacco (and alcohol), the use of potassium iodide, strychnine and corrosive mercuric chloride by mouth for their stimulating and alterative properties, the use of amyl nitrite and glonoin for improving the nutrition of the optic nerve, of pilocarpine sweats or Turkish baths for producing diaphoresis and also of sedatives, subconjunctival injections of corrosive mercuric chloride

From the Herman Knapp Memorial Eye Hospital.

1. de Schweinitz, G.: The Toxic Amblyopias, Philadelphia, Lea Brothers & Co., 1896.

2. (*a*) de Schweinitz, G.: Diseases of the Eye, ed. 8, Philadelphia, W. B. Saunders Company, 1917. (*b*) Knapp, A.: Medical Ophthalmology, Philadelphia, P. Blakiston's Son & Co., 1918.

and the faradic current. As the therapeutic results were approximately the same with regard to the time necessary for improvement in vision for any remedy or remedies just listed, it is probable that none of them was of marked value in bringing about rapid restoration of vision.

The time required for restoration of vision with the treatment described has varied somewhat but, in general, has not been short. Thus, de Schweinitz [1] stated that if these remedies help the scotoma breaks up and disappears in from a few weeks to a number of months. In fifteen of Griffith's [3] patients who returned for follow-up, the best final vision resulted, on the average, in seventeen and six-tenths months, the shortest time being three months and the longest thirty-seven months.

Of 18 of Finlay's [4] patients who were treated with abstinence, potassium iodide and strychnine, 10 (58.8 per cent) attained vision of from 15/30 to 15/15 in one or both eyes in an average time of two and seven-tenths months. (One patient attained vision of 15/30 in nine days.) Four patients (22.2 per cent) attained vision of 15/15 in one or both eyes in an average time of three and two-tenths months, the extremes being one month and five and one-half months. Fuchs [5] stated that from one to two months is required for a cure in the very mild cases with the usual methods of treatment, while Traquair [6a] expressed the opinion that in mild or moderate cases about six weeks is required for improvement, but that in severe cases two or three months may elapse before definite improvement begins. In a later work [6b] he stated that in moderately severe cases good vision is restored in a few months if tobacco is discontinued, but in cases in which there is an extensive dense scotoma in the field for white, with severe impairment of the fields for colors, recovery is always prolonged and usually imperfect.

From a consideration of the cases and opinions cited, it is apparent that, while the best final vision may be attained in nine days (1 case), the average time is probably two months or longer with the former routine treatment.

In 1930, Pflimlin [7] reported a series of cases in which treatment had been based on the supposition that tobacco amblyopia is due primarily to a spasm of the arterioles at some point or points in the visual pathway, a condition not recognizable in dead, fixed and stained optic nerves (or chiasm).

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3. Griffith, A. H.: Tr. Ophth. Soc. U. Kingdom **7**:81, 1887.

4. Finlay, C. E.: Arch. Ophth. **30**:241, 1901.

5. Fuchs, E.: Textbook of Ophthalmology, edited by Alexander Duane, ed. 8, Philadelphia, J. B. Lippincott Company, 1919.

6. Traquair, H. M.: (*a*) Tr. Ophth. Soc. U. Kingdom **50**:351, 1930; (*b*) Introduction to Clinical Perimetry, ed. 2, London, Henry Kimpton, 1931.

7. Pflimlin, R.: Klin. Monatsbl. f. Augenh. **85**:787, 1930.

Pflimlin derived his theory from the earlier works of Sourdille,[8] Schieck,[9] Aubaret and Sédan,[10] Horniker,[11] Imre,[12] Redslob [13] and Scalinci [14] (whose article appeared while Pflimlin's article was in press). Sourdille [8] found endovasculitis with obliteration of the lumen of a blood vessel in a case of optic neuritis due to a streptococcic infection, and in a case of axial optic neuritis (in a patient who had both tuberculosis and syphilis) he found similar vascular changes. It was his opinion that toxic substances in the blood caused (1) endothelial proliferation, then (2) a lesion of the connective tissue of the vascular wall and finally (3) perivasculitis. Schieck [9] found obliterated capillaries without retinal lesions in some cases of retrobulbar neuritis. Aubaret and Sédan [10] predicated vascular spasm as the primary pathologic factor in ophthalmic migraine, ocular arteriosclerosis, glaucoma and retrobulbar neuritis, and they suggested that a similar disorder might be the essential pathologic factor in certain types of optic atrophy, in glaucoma without excavation of the disk, in tobacco amblyopia and in retrobulbar neuritis of nasal, sinusal or dental origin. Horniker [11] treated successfully a patient with central retinitis that was apparently angioneurotic (or capillariospastic) in origin with papaverine, a depressant affecting the smooth muscles. Imre [12] used amyl nitrite with some therapeutic success for spasm of the retinal arteries, familial pigmentary degeneration of the retina, chorioretinitis, albuminuric retinitis and several other conditions. Redslob [13] used acetylcholine for spasm of the central retinal artery. Scalinci [14] expressed the opinion that in chronic toxic amblyopia the involvement of the macular fibers is due not to the preferential action of the poison on these fibers, but rather to its action on a vessel or vessels which nourish these fibers.

In addition to the reports of the authors just cited, there are reports by Kalt, Bollack and Autier, Espíldora, Schiff-Wertheimer, de Saint-Martin and many others who have used acetylcholine successfully for various diseases of the retinal arteries, and a report by Bonnefon,[15] who reported temporary improvement in a case of toxic amblyopia (which he ascribed to alcohol) after a single intramuscular injection of 0.1 Gm. of acetylcholine.

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8. Sourdille, G.: Clin. opht. **6**:280, 1900.
9. Schieck, F.: Arch. f. Ophth. **71**:466, 1909.
10. Aubaret, E., and Sédan, L.: Clin. opht. **17**:255, 1928.
11. Horniker, E.: Arch. f. Ophth. **123**:286, 1929.
12. Imre, J.: Ber. ü. d. Versamml. d. deutsch. Ophth. Gesellsch. **48**:279, 1930.
13. Redslob, E.: Bull. Soc. d'opht. de Paris **3**:143, 1930.
14. Scalinci, N.: Boll. d'ocul. **9**:752, 1932.
15. Bonnefon: Prat. méd. franç. (no. 2, bis) **12**:65 (Feb.) [B] 1931.

As his vasodilating agent Pflimlin used nitroscleran (Tosse).[16] From 20 to 40 mg. of the nitrite was given twice weekly intravenously to his 15 patients for from three to eleven weeks. For the 30 eyes an average of eleven and eight-tenths injections were given in an average time of five and two-tenths weeks. Fifteen eyes (50 per cent) attained vision of 6/8 or better, and 19 (63.3 per cent) attained vision of 6/12 or better in this time; or, to compare these cases with Finlay's, 11 patients (73.3 per cent) attained vision of 6/12 or better in one or both eyes in an average time of five and one-tenth weeks, and 7 (46.6 per cent) attained vision of 6/6 in one or both eyes in an average time of four and nine-tenths weeks. He also noted that in one patient who smoked throughout the treatment vision improved from 3/60 to 6/36 and 6/24 in five weeks. His impression was that with abstinence alone, a year would have been necessary to bring about the results just cited.

Shortly afterward Duggan[17] reported 6 cases (included in the present report) of patients who received, for the most part, from six to eight daily intravenous injections of from 40 to 100 mg. of sodium nitrite as nitroscleran. Among the 12 eyes, vision was unimproved in 2 and improved to 20/30 in 3 and to 20/25 in 5 in an average time of thirteen days. (The other 2 eyes had vision of 20/50 and 20/40.)

László[18] next reported 19 cases of toxic retrobulbar neuritis, in all of which vision improved after twenty injections (the route was not specified) of sodium nitrite. He stated that rapid improvement did not follow abstinence alone.

Shannon and McAndrews[19] reported a case of tobacco amblyopia complicated by diabetes in a patient who received weekly intravenous injections of nitroscleran. After three months vision was 6/9 in each eye.

Recently Cordes and Harrington[20] reported 8 cases of tobacco amblyopia. One patient had vision of 20/20 when first seen, and another had optic atrophy. The other 6 patients received subcutaneous injections of nitroscleran every day or every other day. Of the 12 eyes, 2 showed only slight improvement in vision; the other 10 (83.3 per cent)

16. The composition of nitroscleran (Tosse) is: sodium chloride, 0.6 per cent; di-sodium phosphate, 0.36 per cent; di-potassium phosphate, 0.2 per cent, and sodium nitrite, 10 per cent.

17. Duggan, W. F.: Treatment of Toxic Amblyopia with Vasodilators, Arch. Ophth. **8**:304 (Aug.) 1932.

18. László, G.: Klin. Monatsbl. f. Augenh. **89**:554, 1932.

19. Shannon, C. E. G., and McAndrews, L. F.: Diabetic and Tobacco Amblyopia: Report of a Case, Arch. Ophth. **11**:757 (May) 1934.

20. Cordes, F. C., and Harrington, D. O.: Toxic Amblyopia Due to Tobacco and Alcohol; Treatment with Vasodilators: Report of Eight Cases, Arch. Ophth. **13**:435 (March) 1935.

attained vision of 20/30 or better in an average time of twenty-four days. To compare these results with Finlay's, 5 of the 6 patients (83.3 per cent) attained vision of 20/30 or better in both eyes in an average time of twenty-four days, and 3 of the 6 (50 per cent) attained vision of 20/20 in both eyes in an average time of ten days (the extremes were six and fourteen days).

RELATION OF TOBACCO TO VASCULAR SPASM; IDIOSYNCRASY

While the present article is not intended to be monographic, it was believed that a cursory search of the literature might reveal (1) that the idea of a vascular origin of tobacco amblyopia is not wholly recent, (2) that recent work in other branches of medicine might show that tobacco, when smoked, has a selective action on blood vessels and (3) that this action might be variable in its occurrence, thereby accounting for the well known fact that most heavy smokers do not have amblyopia (i. e., a factor of hypersensitivity must be explained).

In 1874, O. Baer [1] suggested that tobacco amblyopia might be due to spasm of the retinal vessels. This, however, could not be verified by ophthalmoscopy.

Some time later A. Maitland Ramsay [1] pointed out that the papillomacular bundle in certain toxic conditions passes into a state of interstitial neuritis, with proliferation of connective tissue and ultimate cicatricial contraction. He doubted whether typical tobacco amblyopia, which often improves after a good night's rest and which, on the other hand, grows worse with fatigue, is consistent with the theory that the papillomacular bundle is inflamed. Such facts "point rather to the existence of some lesion of a vascular kind."

In 1894, Sachs [21] suggested that endophlebitis or periphlebitis of the vena postica centralis might be the cause of the lesions of tobacco amblyopia.

In 1897, de Schweinitz [22] reported on the pathologic findings in a case of tobacco amblyopia. The retinas were approximately normal. In the optic nerve, in addition to degeneration of the papillomacular bundle, the small nutrient vessels of the optic nerve were thickened and in places converted into small fibrous cords. From his findings he could not assume that the process started in the retina.

In 1898, Holden [23] invoked spasm of the retinal blood vessels as the cause of quinine amblyopia.

In 1901, Parsons [24] concluded that tobacco or some substance in tobacco could cause amblyopia (1) by causing vasoconstriction of the

21. Sachs, T.: Arch. Ophth. **23**:426, 1894.
22. de Schweinitz, G.: Tr. Am. Ophth. Soc., 1897, p. 189.
23. Holden, W.: Tr. Am. Ophth. Soc., 1898, p. 405.
24. Parsons, J. H.: Ophth. Rev. **20**:181, 1901.

arterioles of the macular region and (2) by paralyzing the synapses of the cone fibers or the cone bipolars or both.

In 1928, Raverdino [25] reported the case of a 16 year old boy who smoked twenty-five cigarets daily for two months and who had attacks of foggy vision in the left eye. Ophthalmoscopic examination showed only narrowed arteries and an arterial pulse which appeared after light pressure on the globe. Vision was normal. The field for white and the fields for colors showed a slight contraction. When the patient stopped smoking and used belladonna, the symptoms disappeared after three days.

In the same year Farnarier [26] reported that in many smokers, after the first few puffs, especially if inhaled deeply, there is transient veiling of the central portion of the visual field (with or without slight dizziness), which in rare instances lasts as long as several minutes. He ascribed this to a reflex vascular spasm not necessarily limited to the macula, but part of a general incomplete spasm, and stated that in habitual smokers these attacks, if repeated, can lead to enduring changes and constitute the beginning or basis of toxic amblyopia.

Pflimlin's [7] noteworthy and highly interesting paper to which reference has been made before in this article was next in order of appearance and was followed by the reports of myself,[17] László,[18] Shannon and McAndrews [19] and Cordes and Harrington.[20]

In addition to the aforementioned excerpts from the ophthalmologic literature, workers in other fields of medicine have brought forward evidence which indirectly supports the view that tobacco amblyopia may be vascular in origin.

Maddock and Coller [27] demonstrated that in young adult cigaret smokers, after a very short period of smoking, in addition to a rise in blood pressure and pulse, there was also a decrease in the temperature of the skin of the fingers and toes, which sometimes lasted more than thirty minutes. They expressed the opinion that prolonged or marked vasoconstriction may initiate organic vascular occlusions. These changes may occur not only in the peripheral arterioles, capillaries and venules but also in the peripheral arteries and veins as a result of zones of poor nutrition in their walls through vasoconstriction of the vasa vasorum.

Shortly afterward Wright [28] reported slowing and stasis of the capillary circulation of the nail fold during the smoking of one cigaret. It

25. Raverdino: Rev. d'oto-neuro-opht. **6**:653, 1928.

26. Farnarier: Rev. d'oto-neuro-opht. **6**:647, 1928.

27. Maddock, W. G., and Coller, F. A.: Ann. Surg. **98**:70, 1933.

28. Wright, I. S.: Clinical Value of Human Capillary Studies in Fever, Mental Deficiency, Nephritis, Vascular Diseases, Clubbed Fingers, Smoking and Argyria, J. A. M. A. **101**:439 (Aug. 5) 1933.

often occurred after the first few deep inhalations; sometimes it was transitory; at other times it lasted until the end of smoking. He suggested that a similar local spasm in the brain or heart muscle can cause dizziness, nausea, anginoid pains or other phenomena. He concluded that such reactions in blood vessels may produce end-results of two types: (1) changes in the blood vessels themselves and (2) changes based on irregularities in the distribution of blood in the organs which they supply. He also mentioned an unpublished communication from H. J. Johnson, who found that of 35 subjects who smoked ten minutes or more, 6 showed no change in the temperature of the skin of the fingertips; 2 showed an increase, and 27 showed a fall of from 2 to 11 F. Barker [29] reported similar results.

Finally, Sulzberger,[30] after mentioning earlier similar work of Harkavy, Hebald, Silbert, Wise and others reported a series of observations with regard to the hypersensitivity of man to tobacco. Extracts of whole and of denicotinized tobacco and a 0.4 per cent solution of nicotine sulphate were used; 0.01 cc. of the excitant was injected intradermally. In hypersensitive persons a wheal surrounded by an area of erythema develops within thirty minutes. Thirty-six per cent of 145 smokers and 16 per cent of 58 nonsmokers showed immediate positive wheal reactions to both the whole and the denicotinized tobacco extracts. Only 1 person gave a slight positive reaction to the nicotine solution.

Sulzberger thinks that hypersensitivity confined to a certain organ or part of an organ may develop, that all allergens have their favorite point of attack, that chronic reactions and permanent organic damage may be caused by one or more successive shocks, that an idiosyncrasy for allergens exists, that the vascular system in man is particularly liable to sensitizations and that this system is the most frequent site of reactions, as seems to be the case in bronchial asthma, hay fever, and many cutaneous diseases. And it would appear that in cases in which tobacco causes such sensitivity nicotine is probably not the causal agent.

From these few reports it seems to be definitely proved that some substance in tobacco smoke has a profound effect on the circulation in the tips of the extremities. (The relation of smoking to thrombo-angiitis obliterans is well known.) A similar effect on a small arteriole (or arterioles) in the visual pathway would presumably lead to a reduction in visual acuity, owing to the production of a circumscribed zone of anoxemia. However, while oxygen is necessary for the continued function of nerve fibers, they can be deprived of it for relatively long periods without losing the ability to recover; this is probably due to the limited

29. Barker, N. W.: Proc. Staff Meet., Mayo Clin. **8**:284, 1933.

30. Sulzberger, M. B.: Recent Immunologic Studies in Hypersensitivity to Tobacco, J. A. M. A. **102**:11 (Jan. 6) 1934.

metabolism of the nerve fiber. The last mentioned fact may account for the slow development of tobacco amblyopia.

Sulzberger's work would indicate that the vascular systems of smokers are not equally sensitive to tobacco and may account both for the fact that not all heavy smokers have amblyopia and for the fact that a few smokers have it either after using tobacco for a short while or after using relatively small daily amounts of tobacco. Further work along this line is indicated.

DIAGNOSIS OF TOBACCO AMBLYOPIA

The findings in an ordinary case of tobacco ambylopia have been known for years. Yet the repeated occurrence of statements such as "tobacco amblyopia ruled out because blind spot not enlarged," or "case unusual because there was no enlargement of the blind spot" (in cases in which a 1 or 2 mm. white test object was used with a hand campimeter

TABLE 1.—*Age of Patients with Tobacco Amblyopia (Usher and Elderton)*

Age, Years	Number of Patients	Percentage
21 to 30	37	3.36
31 to 40	149	13.55
41 to 50	302	27.45
51 to 60	332	30.18
61 to 70	187	17.00
71 to 80	82	7.45
81 to 90	7	0.64
Age not stated	4	0.36

at a distance of 16.6 cm., or a 2 or 5 mm. object was used on a standard perimeter at a distance of 33 cm.) seems to demand a short review of the subject.

SALIENT FEATURES OF TOBACCO AMBLYOPIA

Age and Sex.—In 1927, Usher and Elderton [31] reported a detailed statistical study of 1,100 patients with tobacco amblyopia. The distribution according to age, shown in table 1, is interesting.

Twenty-seven of the patients (2.45 per cent) were women whose ages varied between 45 and 74 years. Of Traquair's [6a] 1,525 patients, 7 (0.46 per cent) were women. The age of the men varied between 23 and 84 years, the average being 55.6 years.

Amount of Tobacco Used.—Nettleship [32] reported a case in which amblyopia occurred after the patient had smoked for one year. Berry [33] reported that it could occur after the smoking of from 1 to 8 ounces (31.1 to 248.8 Gm.) of tobacco a week.

31. Usher, C. H., and Elderton, E. M.: Ann. Eugenics **2**:245, 1927.
32. Nettleship: Tr. Ophth. Soc. U. Kingdom **7**:43, 1887.
33. Berry: Tr. Ophth. Soc. U. Kingdom **7**:91, 1887.

In Usher and Elderton's [31] cases the average consumption was 2⅘ ounces (87.08 Gm.) per week, but 21 of their patients used less than 1 ounce a week. In a control series of 500 nonamblyopic smokers the average consumption was 2¾ ounces (85.5 Gm.) per week. However, their patients in whom amblyopia occurred after the age of 50 smoked slightly less a week (2½ ounces—77.7 Gm.) than the nonamblyopic control patients over 50 (2⅔ ounces—82.9 Gm.—per week). In patients under 50 the reverse was true.

Traquair [6a] found that in 1,088 of his cases the weekly consumption varied between ½ and 9 ounces (15.5 and 279.9 Gm.), the average being 3⅛ ounces (97.2 Gm.).

Status of Alcohol.—While alcohol was thought to be an etiologic factor in tobacco amblyopia, numerous observers have reported many cases in which either no alcohol or very little alcohol had been used. De Schweinitz [1] noted that Berry, Nettleship, Eales, Gunn and many others had never seen a case in drinkers who did not also smoke. Traquair [6a] found no marked correlation between alcohol and amblyopia in his series of 1,525 cases. Furthermore, Usher and Elderton [31] reported that 112 of their 1,100 patients were total abstainers, and that two thirds of their patients drank no more than one glass of beer, wine or whisky daily. They also offered as evidence of the nonimportance of alcohol the fact that in their cases the greatest improvement occurred in the moderate drinkers, while the moderate smokers (who used no alcohol) showed the least improvement. In view of the vasodilating property of alcohol, this observation is interesting.

The Fundus.—Normal fundi are the rule in the early stages. Knapp [2b] mentioned that about 8 per cent of the patients show hyperemia of the disk. Patients with cases of longer duration show temporal pallor, while patients with a long-standing or untreated condition show temporal atrophy of the disk. As the majority of the patients are over 40 years of age, it is not unusual to find moderate changes (hypertensive or arteriosclerotic) in the retinal vessels.

Vision.—Reference to de Schweinitz,[1] Finlay,[4] Traquair [6] and Pflimlin [7] discloses that vision may be as poor as 5/200 or as good as 20/25 at the first visit of the patient. One eye is often more affected than the other, but field defects are always demonstrable in both eyes, even if vision in one eye is normal. Hutchinson [34] reported a case in which one eye retained normal vision for six months after vision had failed in the other eye. However, the eye with normal vision had a defect in the field for red.

The Scotoma.—Although atypical fields have been described by de Schweinitz,[1] Vossius,[35] Krimsky [36] and others, the usual defect, as

34. Hutchinson, J.: Tr. Ophth. Soc. U. Kingdom **7**:62, 1887.
35. Vossius, A.: Klin. Monatsbl. f. Augenh. **21**:291, 1883.
36. Krimsky, E.: Am. J. Ophth. **17**:722, 1934.

found on the tangent screen at a distance of 1 meter, which has been well described by Traquair,[6] is cecocentral and horizontally oval and is best detected with a red or a small white test object.

The defect in the field for red is easily detected with a 5 or 10 mm. test object; in the early stages it consists of a tongue-shaped projection toward the fixation point from the blindspot. In conditions of longer duration or in more severe conditions the red test object is either seen only in a crescentic area in the nasal side of the field or not perceived at all.

The defect in the field for white is always much smaller than that in the field for red (disproportion). As a rule, testing with a 0.5 or 1 mm. object at a distance of 1 meter (0.5/1,000 or 1/1,000) is necessary to demonstrate that the defect is cecocentral. In this defect one or two nuclei for a 2 mm. test object at a distance of 1 meter or, occasionally, a 5 mm. white test object at a distance of 1 meter can usually be demonstrated. When single, the nucleus lies between the blindspot and the fixation point; when double, one nucleus is usually just to the outer side of the fixation point, and the other lies near or at the nasal side of the blindspot. Excentric fixation may alter the position of the nucleus near the fixation point. It must be stated emphatically that the blindspot is usually not enlarged in the field for white. When it is enlarged, a very small visual angle (usually that for a 1 or 0.5 mm. test object at a distance of 1 meter) is usually necessary to elicit it. Obviously the visual angle for a 1 mm. object at a distance of 16.6 cm. is approximately the same as that for a 6 mm. object on the tangent screen at a distance of 1 meter.

Except in cases in which the condition is of long standing, the margins of the scotoma in the field for white are very sloping, indicating a favorable prognosis. Cases in which the condition is of long standing show a steep-edged scotoma, the defects shown by a 1 mm. test object and for a 5 mm. test object at a distance of 1 meter having approximately the same size.

Central visual acuity is impaired only when the defect in the field for white overlies the fixation point. The extent of impairment also seems to depend on whether or not one of the nuclei already mentioned is at or very close to the fixation point.

The peripheral field is usually not damaged. Occasionally there is a slight peripheral depression for a 0.5 mm. object at a distance of 1 meter or a 1 mm. object at a distance of 1 meter.

During recovery the scotoma retraces its steps, i. e., the field for red enlarges, and the defect in the field for white shrinks. However, a defect in the field for red may exist for months after vision returns to normal. The scotoma in the field for white also persists for some time after vision is normal.

The essential features of the changes in the field are the bilateral defects, the limitation of the defect in the field for white almost exclusively to the temporal field and the disproportion between the defects in the field for red and those in the field for white.

As Thomasson [37] pointed out, colored test objects are important chiefly in making the differential diagnosis of tobacco amblyopia, because in many apparently normal eyes the ability of patients to perceive or to interpret colors varies greatly.

It is also my opinion that the scotoma in the field for white is the important defect, that most of the time spent in field taking in these cases should be devoted to determining the character of the defect in the field for white, and that the preliminary survey of the field should be first made with a visual angle for a 1 mm. test object at a distance of 1 meter.

ANALYSIS OF THIRTY-FOUR CASES OF TOBACCO AMBLYOPIA IN PATIENTS TREATED WITH NITROSCLERAN

During the past three and one-half years 30 patients with tobacco amblyopia have been treated with nitroscleran (Tosse) [38] at the Herman Knapp Memorial Eye Hospital. In addition, the results in 4 cases in patients treated similarly in private practice were made available for this report by Dr. Arnold Knapp, Dr. A. B. Reese and Dr. Franklin Bracken.

Procedure.—As complete a history as possible was obtained from all the patients. The patients' statements as to the amount of tobacco used and the duration of use (especially the latter) were somewhat vague, so the data on these points are only approximate. Likewise, with regard to the amount of alcohol used, it was necessary to depend almost entirely on the statements of the patients. Thus, in table 2, in the 3 cases listed as "slight," the amounts of alcohol consumed were: "one pint [473.18 cc.] of alcohol daily for three months," "three glasses of 'anything' per week" and "a little wine daily." Of the 3 cases listed as "heavy," one (case 10) was that of a person with chronic alcoholism with chronic nephritis and hypertension, who died a year after treatment, following an alcoholic debauch; one (case 14) was that of a patient who was said to be a heavy drinker by her own physician, and the third (case 15) that of a patient who admitted that he had been a heavy drinker until he reduced his consumption of alcohol to two bottles of wine per week.

In all the cases the vision stated is with correction. The refractive errors were small for the most part, so they were not included.

The visual fields were taken on the Thomasson tangent screen at a distance of 1 meter, with 1, 2 and 5 mm. white test objects and 5 or 10 mm. red test objects, before and at suitable intervals during and after treatment. Daylight illumination was used.

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37. Thomasson, A. H.: Arch. Ophth. **12**:21, 1934.

38. Footnote 16. A 1 cc. ampule of nitroscleran contains 100 mg. of the sodium nitrite. A weaker solution, containing 40 mg. of sodium nitrite per cubic centimeter, is also available. The first 11 patients treated received the weaker solution for the first three doses. As there were no unfavorable reactions, all the patients treated were later given the 100 mg. dose. All the doses were given intravenously.

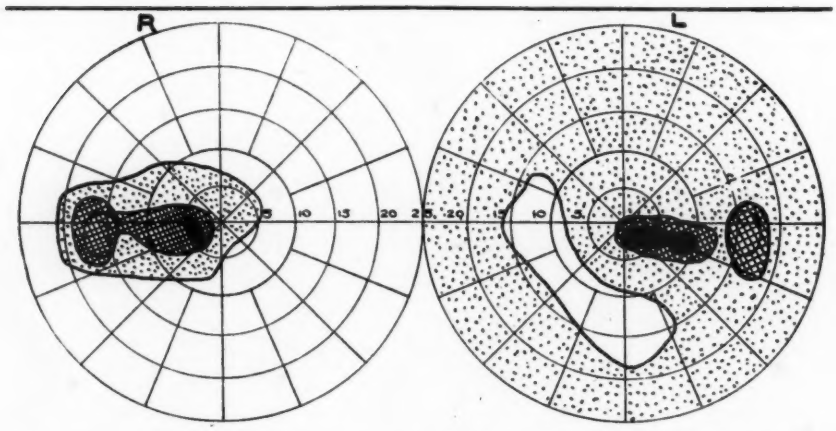

Fig. 1 (case 11).—Fields after two injections of nitroscleran. Vision in the right eye was 20/30 and in the left, 20/50. The fields show a cecocentral scotoma for a 2 mm. white test object at a distance of 1 meter, with a relatively large nucleus for a 5 mm. white test object at a distance of 1 meter. The field for red taken with a 10 mm. test object at a distance of 1 meter, is limited in the left eye to the lower nasal part of the field. The blindspots are not enlarged. In both the figures the solid black area indicates a defect in the field for white for a 5 mm. test object at a distance of 1 meter; the area of cross-hatching, a defect in the field for white for a 2 mm. test object at a distance of 1 meter; the area of parallel lines, a defect in the field for white for a 1 mm. test object at a distance of 1 meter, and the dotted area, a defect in the field for red for a 10 mm. test object at a distance of 1 meter.

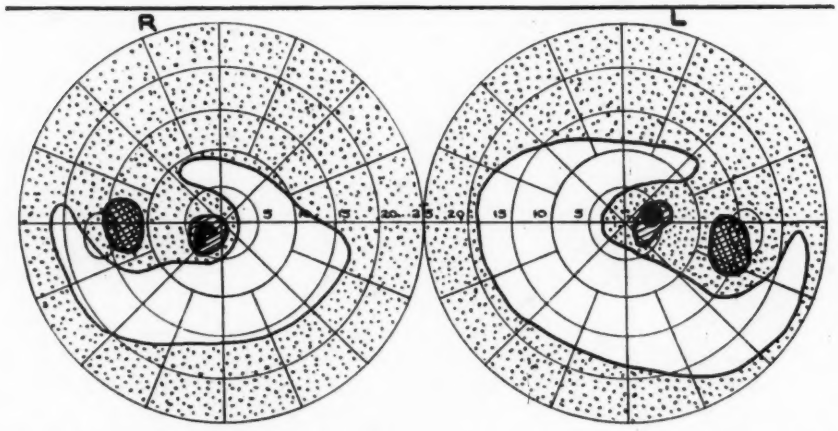

Fig. 2 (case 24).—Fields before the use of nitroscleran. Vision in the right eye was 20/70 and in the left, 20/20. Both fields show a small paracentral scotoma for a 1 mm. white test object at a distance of 1 meter, with a relatively large nucleus for a 5 mm. white test object at a distance of 1 meter. A defect in the field for red for a 10 mm. test object at a distance of 1 meter shows "breaking through" in both upper temporal regions. The blindspots were not enlarged for a 2 mm. white test object at a distance of 1 meter.

Medical, dental, nasopharyngeal and neurologic examination and examination of the blood were made when indicated. One case of diabetes (case 6) was discovered.

The patients were followed after treatment as long as they could be induced to return to the clinic. As a whole, they were uncooperative; as soon as their vision showed definite marked improvement they tended to stay away, and it required several messages to induce some of them to return, while many failed to return.

Most of the patients received from six to ten intravenous injections of nitroscleran daily. In cases in which this was impossible, injections were given every other day or every third day. One patient received only three injections, and 4 patients received more than sixteen injections. During treatment vision was tested immediately before and from thirty to sixty minutes after each injection. All the patients were ambulatory except 1 (patient 31), who was hospitalized for disciform keratitis.

Since the patients were ambulatory, studies of the blood pressure were not carried out. Nitroscleran has been used abroad for many years for lowering the blood pressure in hypertension. Jaensch [39] found in patients kept completely at rest a fall of from 20 to 40 mm. after a single injection of this preparation, and he prefers it to phlebotomy preliminary to intra-ocular operations in cases in which intra-ocular hemorrhage might occur at the time of opening the globe.

Lack of space prevents the inclusion of the charts of the fields for each patient. Figures 1 and 2 represent typical findings in 2 cases.

Of the 34 cases of tobacco amblyopia there were 24 in which there was no optic atrophy (table 2) and 10 in which there was definite temporal optic atrophy (table 4). Among the patients there were 10 Americans, 9 Italians, 7 Irish persons and 3 Negroes. The average age of all the patients was 51.5 years, and 22 (64.7 per cent) were between 41 and 60 years of age.

The average age of the 24 patients without optic atrophy (including 2 women, aged 35 and 45) was 52, while the average age of the 10 patients with optic atrophy was 60.

The average amount of tobacco used per week was estimated to be 5⅔ ounces (176.3 Gm.) and the average duration of use was twenty-three and five-tenths years. The least total amount of tobacco used was 5 ounces (155.5 Gm.) per week for two years; the greatest, 10 ounces (311 Gm.) per week for twenty-five years. The least amount used per week was 1½ ounces (46.7 Gm.), the greatest 16 ounces (497.6 Gm.). The shortest period of use (before amblyopia occurred) was two years, the longest fifty years.

Results in Twenty-Four Patients Without Optic Atrophy.—In table 2 are included all the essential data except those pertaining to the field defects, which were typical in all the cases. In the last four colums are given: (1) the best final vision attained in each eye, (2) the number of days required to attain that vision, (3) the number of intravenous injections of nitroscleran given in this time and (4) the time of follow-up from the first day on which treatment was instituted.

There seemed to be no correlation between the rapidity or slowness of visual improvement and the amount of tobacco smoked (in agreement with the findings of Usher and Elderton [31]), the condition of the fundus

39. Jaensch, K.: Klin. Monatsbl. f. Augenh. **77**:189, 1926.

TABLE 2.—*Data for Cases of Tobacco Amblyopia Without Optic Atrophy*

Case	Age, Years	Duration of Loss of Sight	Tobacco Used: Amount per Week	Tobacco Used: Years Used	Amount of Alcohol	Vision Before Treatment	Fundi	Intravenous Injections of Nitroscleran	After Treatment Began: Best Final Vision Attained	After: Days	After: Injections	Patient Followed
1	42	2 wks.	Moderate		Moderate	R, 6/200 L, 6/200	Optic neuritis	8 in 9 days	R, 20/20— L, 20/25	26 14	8 8	26 days
2	56	3½ mos.	3½ oz.	20	Slight	R, 20/200 L, 20/70	Normal	6 in 6 days	R, 20/40 L, 20/30	4 2	4 2	14 days
3	62	6 mos.	6 oz.	20	Moderate	R, 20/100 L, 20/100	Temporal pallor, arteries small	6 in 6 days	R, 20/25 L, 20/25	8 8	6 6	2 mos.
4	50	3 wks.	9 oz.	20	None	R, 20/100 L, 20/200	Normal	11 in 13 days	R, 20/70 L, 20/100	4 5	4 5	2½ mos.
5	65	6 mos.	7 oz.	30	None	R, 20/200 L, 20/70	Temporal pallor	33 in 67 days	R, 20/20 L, 20/20	52 52	25 25	3 mos.
6	58	3 mos.	8 oz.	6	None	R, 20/100 L, 20/50	Temporal pallor	7 in 13 days	R, 20/50 L, 20/30	2 4	2 4	14 days
7	52	1½ mos.	2¼ oz.	10	Moderate	R, 20/30 L, 20/40	Normal	8 in 12 days	R, 20/20 L, 20/20	2 3	2 3	2 yrs.
8	44	4 mos.	1⅜ oz.	26	Slight	R, 20/100 L, 10/200	Temporal pallor	7 in 17 days	R, 20/20 L, 20/25	45 17	7 7	1½ mos.
9*	66	2 mos.	3¼ oz.	50	None	R, 3/200 L, 3/200	Normal	16 in 24 days	R, 20/25 L, 20/25	30 30	16 16	1½ mos.
10†	35	3 mos.	4½ oz.	20	Heavy	R, 16/200 L, 18/200	Normal	5 in 6 days	R, 20/70 L, 20/70	6 6	5 5	6 days
11	38	2 mos.	8½ oz.	15	Moderate	R, 20/50 L, 20/100	Temporal pallor, arteries small, veins distended	7 in 8 days	R, 20/20 L, 20/25	8 8	7 7	8 days

12*	54	6 mos.	2½ oz.	30	None	R, 8/200 L, 20/70	Normal	8 in 8 days	R, 20/30 L, 20/30	20 20	8 8	5 wks.
13	65	10 mos.	2¾ oz.	20	Moderate	R, 20/70 L, 20/30	Faint white dots in macular regions	7 in 10 days	R, 20/30 L, 20/25	5 10	4 7	17 days
14†	45	?	Heavy		Heavy	R, 20/200 L, 20/200	Normal	6 in 7 days	R, 20/40 L, 20/20	7 7	6 6	4 mos.
15*	44	6 mos.	7 oz.	25	Heavy	R, 20/70 L, 20/100	Temporal pallor	9 in 18 days	R, 20/20 L, 20/40	18 10	9 4	17 days
16	58	2½ mos.	5¾ oz.	20	None	R, 20/30 L, 20/200	Normal	8 in 8 days	R, 20/20 L, 20/20	6 8	6 8	8 days
17	56	4 mos.	10 oz.	20	Moderate	R, amblyopia L, 20/100	Arteries threadlike	6 in 6 days	..... L, 20/30	.. 5	.. 5	4 mos.
18	42	?	5 oz.	2	None	R, 20/200 L, 20/70	Normal	6 in 6 days	R, 20/30 L, 20/20	24 2	6 2	1 mo.
19	42	5 mos.	10 oz.	15	None	R, 3/200 L, 5/200	Temporal pallor	14 in 50 days	R, 20/20 L, 20/25	52 52	14 14	2½ mos.
20	50	3 mos.	3½ oz.	?	Moderate	R, 20/30 L, 20/70	Temporal pallor	6 in 6 days	R, 20/25 L, 20/50	1 16	1 6	16 days
21	56	R, 1 yr. L, 3 mos.	2½ oz.	30	Moderate	R, 6/200 L, 20/200	Normal	11 in 25 days	R, 20/200 L, no change	1 ..	1 ..	2½ mos.
22*	58	1 yr.	5 oz.	20	Slight	R, 20/200 L, 20/200	Arteries thickened, lumens small	10 in 30 days	R, 20/25 L, 20/20—	120 120	10 10	4 mos.
23*	42	10 mos.	6¼ oz.	20	None	R, 20/50 L, 20/100	Temporal pallor	6 in 6 days	R, 20/20 L, 20/25	15 8	6 6	2½ mos.
24	45	6 mos.	16 oz.	10	None	R, 20/70 L, 20/20	Smaller arteries constricted	3 in 3 days	R, 20/25 L, no change	6 ..	3 ..	4 mos.

* The patient smoked during part or all of the treatment. See table 5.
† Woman.

or the length of time symptoms had existed before treatment was begun (with the exception of cases 21 and 22).

In both case 4 and case 21 the condition was relatively unimproved after eleven injections. In fact, after a very slight temporary improvement the scotomas slowly increased in size and density both during and after treatment. An explanation for this phenomenon will be offered later.

In case 10 vision improved from 16/200 to 20/70 after five injections in six days. This patient, who lived in the country, could not be induced to return for further examination or treatment. However, it was later learned that her vision had improved sufficiently to satisfy her.

The 21 remaining patients (87.5 per cent) attained vision of 20/30 or more in one or both eyes in an average time of eighteen and four-tenths days.[40] However, among these 21 patients were 5 (table 5) who smoked during part or all of their period of treatment. The average time in which these 5 patients attained vision of 20/30 or more in one or both eyes was thirty-six and two-tenths days, while in the 16 cases in which abstinence was also a feature of the treatment the average time for similar improvement was eleven and nine-tenths days, and 10 of these patients attained this result in from one to seven days.

Among the 30 eyes of the 16 patients for whom abstinence was part of the treatment 12 eyes (40 per cent) attained vision of 20/20; 9 (30 per cent) attained vision of 20/25; 5 (16.6 per cent) attained vision of 20/30; 2 (6.7 per cent) attained vision of 20/40, and 2 (6.7 per cent) attained vision of 20/50 in an average time of fifteen and three-tenths days per eye.

Also, of the 16 patients who did not continue smoking, 4 (patients 5, 6, 8 and 19) received an injection every other day or every third day (the average number of injections given was fourteen). Final vision in these cases was: 20/20 in 4 eyes, 20/25 in 2 eyes and 20/30 and 20/50 in the remaining eyes. The average time of improvement was thirty-four and five-tenths days per eye, which is approximately the same figure as Pflimlin obtained, using injections twice weekly. The remaining 12 patients received an average of six injections in an average time of six and nine-tenths days. (Most patients received a daily injection, and none received an injection less often than twice in three days.) Final vision in the 22 eyes of these 12 patients was: 20/20 in 8 eyes, 20/25 in 7 eyes, 20/30 in 4 eyes, 20/40 in 2 eyes and 20/50 in 1 eye. The average time of improvement was eight and two-tenths days per eye.

40. The time in which vision of 20/30 or better was attained earliest in one eye was used as a basis for this result. Thus, in case 13, in which vision in the right eye was 20/30 in five days and that in the left was 20/25 in ten days, five days was used as the time of improvement.

Therefore, from a study of these 16 patients who were treated only with nitroscleran plus abstinence, it would appear that better results are obtained by giving a few daily injections than by giving more injections less frequently, although the end-results will probably be about the same, whichever routine is used.

Table 3 gives the results with regard to the rapidity with which the best final vision was attained in the smokers as compared with the smoker-drinkers in the 40 eyes in the 21 cases listed in table 2 in which vision was improved. (Cases 4, 10 and 21 are omitted.) In my opinion the eyes should be considered individually in these cases, as the original depression in vision depends on the size, position and density of the scotoma, and the two eyes rarely show identical defects.

A study of table 3 discloses the interesting fact that attainment of the best final vision was definitely more rapid in the smoker-drinker

TABLE 3.—*Rapidity of Visual Improvement in Smokers and Smoker-Drinkers in the Twenty-One Cases in Which Vision Improved with Nitroscleran* *

Best Final Vision Attained in	Smokers—17 Eyes			Smokers-Drinkers—23 Eyes			Total	
	Vision	Eyes	Percentage	Vision	Eyes	Percentage	Eyes	Percentage
1- 3 days	20/20, 20/50.....	2	11.8	20/20 (2), 20/25, 20/30....	4	17.4	6	15.0
4- 7 days	20/20, 20/25, 20/30	3	17.6	20/20, 20/30 (2), 20/40 (2)	5	21.7	8	20.0
8-14 days	20/20, 20/25.....	2	11.8	20/20, 20/25 (5), 20/40....	7	30.4	9	22.5
15-21 days	20/20, 20/30 (2)...	3	17.6	20/20, 20/25, 20/50.....	3	13.0	6	15.0
22-30 days	20/25 (2), 20/30...	3	17.6	20/20.....	1	4.4	4	10.0
1- 2 mos.	20/20 (3), 20/25...	4	23.5	20/20.....	1	4.4	5	12.5
3- 4 mos.	.....	..	....	20/20, 20/25.....	2	8.7	2	5.0

* The data for cases 4 and 21, in which the condition did not improve, and for case 10, in which the patient did not return after the sixth day, are omitted.

group than in the smoker group. Thus, at the end of two weeks 69.5 per cent of the eyes of the patients in the former group had attained their best final vision, as contrasted with 41.2 per cent of those of the patients of the latter group. If the cases in which the patients smoked during part or all of their treatment are omitted, approximately the same percentage of difference exists between the two groups. Moreover, if the cases of the "slight" drinkers are considered as borderline cases and grouped with the smokers, the difference just noted is even more marked.

Therefore, the results in the 21 cases of table 3 agree with Usher's statement that in tobacco amblyopia moderate drinkers improve more rapidly than those who use tobacco exclusively.

In the last two columns of table 3 are given the figures showing the rate of improvement for the total of 40 eyes (in the 21 cases in which the condition improved). As is apparent, the best final vision was attained in 57.5 per cent of the eyes in fourteen days.

With regard to cases 4 and 21, in which the patients showed a very slight temporary improvement in vision followed by a decrease in vision and an increase in the scotoma, it is my opinion that actual thrombosis of the vessel or vessels involved had occurred, and that the thrombosis increased during the time of observation. In other words, ordinary tobacco amblyopia is somewhat analogous to angina pectoris, while in these 2 cases the condition was analogous to coronary thrombosis which is not aided by a vasodilator.

In case 24 the patient was given seven intramuscular injections of acetylcholine in nine days, some time before nitroscleran was used. Vision in the left eye improved from 20/30 to 20/20 after the third injection, while vision in the right eye, which was 20/70 before treatment with acetylcholine, was unchanged one week after the injections were discontinued, although during treatment the patient occasionally had vision of 20/50 directly after an injection. He was then given three daily injections of nitroscleran; three days later he had vision of 20/25 which was maintained for more than two months. After four months he read a few letters on the 20/20 line. A remnant of the scotoma was still present in each eye.

Results in Ten Patients with Optic Atrophy.—Table 4 gives the essential data for 10 cases of tobacco amblyopia with optic atrophy. The duration of impaired vision varied between four months (?) and two years, except in case 31, in which the patient had noticed impairment of vision for ten years but did not seek medical treatment until disciform keratitis developed in the right eye.

It is of some interest that 3 of these patients had been sold glasses by optometrists several months earlier and were told that if the glasses did not aid them nothing would help their vision.

In 2 cases—30 and 34—the patients attained vision of 20/30 in both eyes in thirty-nine and thirty-six days, respectively. In case 34 the patient did not return for follow-up, but in case 30 a field defect was present for many months afterward.

In one case—33—the condition was not improved. As the patient had a hypermature cataract in his right eye, the diagnosis was based chiefly on the character of the scotoma in the visual field of the left eye.[41]

All the other 7 patients showed a slight improvement in vision, which was maintained as long as they were followed, except in cases 25 and 32. (See footnotes to table 4.)

All these patients had dense scotomas with steep edges (except in cases 30 and 34) and in most cases no vision for a 10 mm. red object on the tangent screen at a distance of 1 meter.

41. The cataract has since been removed. Vision in the right eye is 20/70 (corrected); there are partial optic atrophy and a dense cecocentral scotoma.

In case 34 the patient volunteered the information that his vision apparently failed more rapidly after he discontinued the use (or abuse [?]) of alcohol.

Results in Seven Patients Who Continued Smoking During Part or All of Treatment.—As Pflimlin had reported improvement in one of his cases, in spite of the continued use of tobacco, several patients were told to continue the use of tobacco while receiving nitroscleran. Cases 22 and 31, in which the patients refused to abstain from tobacco during part of their treatment, also became available for inclusion among these cases.

TABLE 4.—*Data for Cases of Tobacco Amblyopia with Optic Atrophy*

Case	Age, Years	Duration of Loss of Sight	Amount of Tobacco per Week; Years Used	Amount of Alcohol	Vision Before Treatment	Intravenous Injections of Nitroscleran	After Treatment Began: Best Final Vision Attained	After: Days	After: Injections	Patient Followed
25	64	1 yr.	Heavy ? yrs.	Heavy	R, 20/200 L, cataract	6 in 6 days	R, 20/100	6	6	6 mos.†
26	57	2 yrs.	2½ oz. 40 yrs.	None	R, 12/200 L, 8/200	16 in 20 days	R, 18/200 L, 18/200	27 27	16 16	9 wks.
27	55	1 yr.	2¼ oz. 42 yrs.	Slight	R, 5/200 L, 5/200	8 in 10 days	R, 13/200 L, 15/200	10 7	8 6	10 days
28	39	8 mos.	2½ oz. 15 yrs.	None	R, 3/200 L, 6/200	15 in 25 days	R, 20/200 L, 20/200	41 29	15 15	6 wks.
29	69	4 mos.(?)	1½ oz. 40 yrs.	None	R, 3/200 L, 4/200	6 in 9 days	R, 20/200 L, 20/200	3 3	3 3	9 days
30	73	6 mos.	1⅘ oz. 40 yrs.	None	R, 20/70 L, 20/50	25 in 61 days	R, 20/30 L, 20/30	39 39	20 20	11 mos.
31*	54	10 yrs.	4½ oz. 30 yrs.	None	L, 20/70	9 in 25 days	L, 20/50	10	6	13 mos.‡
32	70	1 yr.	8 oz. 25 yrs.	None	R, 20/100 L, 20/70	10 in 33 days	R, 20/50 L, 20/50	6 4	6 4	7 mos.§
33	69	5 mos.(?)	10 oz. ? yrs.	Moderate	R, cataract L, 18/200	6 in 6 days	..... L, no change	..	..	5 mos.‖
34*	50	1 yr.	10 oz. 25 yrs.	Heavy	R, 20/100 L, 20/70	9 in 17 days	R, 20/30 L, 20/30	36 8	9 6	36 days

* The patient smoked during part or all of the treatment. See table 5.
† Vision returned to 20/200 after six weeks.
‡ The patient had disciform keratitis of the right eye at the first visit. Final vision in the right eye was 20/70.
§ The patient also had arteriosclerotic optic neuritis. At the last visit vision was 20/200 in the right eye and 20/100 in the left.
‖ The patient was uncooperative and spoke no English. There was a field defect in the left eye similar to that in tobacco amblyopia of long standing.

The essential data concerning these cases are to be found in table 5. The total time in the last column is from the day on which treatment was begun until the day on which the best vision was attained.

It is readily seen that in all the cases except 31 (see table 4) the patients made satisfactory and substantial gains in visual acuity. The average time of attainment of the best final vision for the 13 eyes was thirty-four days per eye, but 8 of these eyes attained the best vision in from eight to twenty days.

These results corroborate Pflimlin's statement that the vasodilator effect of the nitroscleran is sufficient to overcome the vasoconstrictor effect of the tobacco.

The data for these 7 cases are offered not as evidence that abstinence is unnecessary in treating tobacco amblyopia but rather to demonstrate that if the patient refuses to curtail or give up smoking entirely his chance of obtaining useful vision is much greater than could be expected with treatment in which abstinence from tobacco is the major element.

TABLE 5.—*Data for Patients Who Smoked During Part or All of Treatment*

			While Smoking			After Stopping Smoking	
Case	Vision Before Treatment	Fundi	Days	After Intravenous Injections Nitroscleran	Vision Improved to	Best Final Vision Attained	Total Time
9	R, 3/200 L, 3/200	Normal	12	12	R, 20/70 L, 20/40	R, 20/25 L, 20/25	30 days 30 days
12	R, 8/200 L, 20/70	Normal	10	8	R, 20/40 L, 20/40	R, 20/30 L, 20/30	20 days 20 days
15	R, 20/70 R, 20/100	Temporal pallor	10	4	R, 20/25 L, 20/40	R, 20/20 L, no further change	18 days
22	R, 20/200 L, 20/200	Arteries thickened	64	10	R, 20/200 L, 20/40	R, 20/25 L, 20/20—	4 mos. 4 mos.
23	R, 20/50 L, 20/100	Temporal pallor	4	4	R, 20/30 L, 20/30	R, 20/20 L, 20/25	15 days 8 days
31*	L, 20/70	Temporal optic atrophy	10	6	L, 20/50	No further change	
34	R, 20/100 L, 20/70	Temporal optic atrophy	8	6	R, 20/50 L, 20/30	R, 20/30 L, no further change	36 days

* Disciform keratitis of the right eye. The patient smoked for nine months after treatment was begun, with no further change in vision.

SUMMARY

The therapy of tobacco amblyopia prior to 1930 is briefly described.

The idea that tobacco may cause amblyopia by bringing about vasoconstriction of the vessels supplying the papillomacular bundles is traced from Baer to Pflimlin. Experiments by workers outside the field of ophthalmology have furnished clinical proof that smoking has a vasoconstrictor action on the peripheral vessels, and that some persons are hypersensitive to a substance in tobacco other than nicotine.

The results of the use of nitroscleran in the treatment of tobacco amblyopia are briefly reviewed.

A short review of the salient features of tobacco amblyopia is included.

The results of treatment in 24 cases of tobacco amblyopia without optic atrophy in which the patients were treated with nitroscleran injected intravenously are described at length.

Two patients were relatively unimproved, and 1 patient who was showing improvement failed to return after six days.

The remaining 21 patients (87.9 per cent) attained vision of 20/30 in one or both eyes in an average time of eighteen and four-tenths days, having received an average of nine injections in fifteen days.

Five of these patients smoked during part or all of their treatment. Their average time of improvement was thirty-six and two-tenths days.

In the 16 cases in which the patients did not smoke the average time for similar improvement was eleven and nine-tenths days, and in 10 of these cases this result was attained in from one to seven days.

Improvement in vision was definitely more rapid in the patients who received daily intravenous injections of nitroscleran (the average time was eight and two-tenths days per eye) than in those who received injections every second or third day (the average time was thirty-four and five-tenths days per eye).

Improvement was definitely more rapid in the tobacco-alcohol group than in the tobacco group.

Of 10 patients with tobacco amblyopia with temporal optic atrophy, 2 showed marked improvement; 7 showed slight improvement, and in 1 the condition was unimproved.

Seven of the total 34 patients smoked during part or all of their treatment. Definite improvement occurred in all these while they were smoking, and 8 of the 13 eyes involved attained their best final vision in from eight to twenty days.

CONCLUSIONS

1. The use of from six to ten daily intravenous injections of 100 mg. of sodium nitrite (as nitroscleran) brings about rapid restoration of vision in cases of tobacco amblyopia uncomplicated by optic atrophy.

2. In cases in which temporal optic atrophy is present the prognosis is poorer, but some improvement may be expected.

3. At present it is not known whether a simple solution of sodium nitrite would be as effective as nitroscleran.

4. Whether or not the sodium nitrite acts other than as a vasodilator has not been determined.

5. In uncomplicated cases, even if the use of tobacco is continued, definite improvement in vision may be expected.

6. Careful scotometry on a tangent screen with small white (1, 2 and 5 mm.) and red (5 or 10 mm.) test objects is essential for accurate diagnosis and prognosis.

7. While histopathologic evidence is lacking to confirm the hypothesis that the development of tobacco amblyopia is due primarily to a vascular spasm in the visual pathway, yet, because of the uniformly good results obtained with treatment based on this hypothesis, such cases deserve a trial with vasodilators. The treatment seems to be safe as well as effective.

News and Notes

EDITED BY DR. JOHN HERBERT WAITE

SOCIETY NEWS

Philadelphia County Medical Association, Eye Section.—The Eye Section of the Philadelphia County Medical Society held its scientific meeting on May 2. The following program was presented:

"Hyperphoria with O'Connor Cinch of the Superior Rectus Muscle." Presentation of a patient. Dr. J. E. Wilson.

"Filaria Loa in the Lid and Conjunctival Sac." Dr. Harry S. Weaver Jr.

"The Occurrence of Cholesterin in the Vitreous." Presentation of a patient. Dr. C. W. LeFever.

"Some Comments on the Production of Cholesterin." Dr. William Egbert Robertson.

"The Surgical Aspects of Glaucoma." Dr. Charles R. Heed.

DEATHS

Arthur Thompson, professor of anatomy at Oxford University, died on February 7. He was trained by Sir William Turner at Edinburgh and came to Oxford at the age of 27 years to build up the department of anatomy. In this he was most successful. He made many contributions to the knowledge of the human body, but his best work was on the human eye. He succeeded in making preparations which demonstrated new points and which were of great beauty. These were photographed and formed the basis of his well known book, "The Anatomy of the Human Eye." It was because of his interest in the eye that the department of anatomy became the meeting place for the Oxford Ophthalmological Congresses.

GENERAL NEWS

Leslie Dana Gold Medal.—The Leslie Dana Gold Medal, awarded annually for outstanding achievements in the prevention of blindness and the conservation of vision, was presented to Dr. William H. Wilder of Chicago, on May 18, in St. Louis. The medal is offered by a director of the St. Louis Society for the Blind and was awarded last

year to Prof. F. de Lapersonne of Paris, president of the International Association for the Prevention of Blindness. Dr. Wilder is secretary-treasurer of the American Board of Ophthalmology; vice-president of the Illinois Society for the Prevention of Blindness; professor emeritus of ophthalmology at Rush Medical College, University of Chicago, and a past president of the American Academy of Ophthalmology and Otolaryngology.

Correspondence

"CYTOID BODIES"

To the Editor.—In the issue of the ARCHIVES OF OPHTHALMOLOGY for March (**13:** 391, 1935) there appears a paper by A. J. McLean on "Cytoid Bodies," in which he makes it appear that I have attached great diagnostic importance to cytoid bodies in gliomas of the optic nerve. The chief purpose of the paper seems to be to refute this alleged contention. As a matter of fact, in only the two contributions referred to by this author have I discussed cytoid bodies, and in these only briefly; in neither did I state or even imply that the bodies in question were of diagnostic importance. I stated that I had never seen them elsewhere than in gliomas and in the retina. But, for the reason that I have not made an exhaustive search for them in other tissues, I did not draw the conclusion that they never occur elsewhere. The author does not expressly give me credit for showing that the bodies are derived from extravasated blood, although he apparently arrives at the same conclusion as regards their most common origin. He seems to take exception to my statement that in gliomas they are within the neuroglia syncytium, but he gives no evidence to refute it.

In what seems to be a spirit of ridicule he quotes me as follows: "they have been generally disregarded," and "general pathologists have given them little attention." Here again nothing is brought forward to refute these statements. On the contrary, they are confirmed by what the author says later, as well as by the evident fact that only recently has he himself become aware of the existence of these bodies. The author states that "these bodies may on occasion, however, apparently arise by a process of inspissation from any static albuminous interstitial fluid (transudate, exudate or edema), or by coagulation necrosis and inspissation of what might appear once to have been overladen wandering cells." This statement is unsupported by any definite evidence and raises grave doubt in my mind that the bodies he has found elsewhere are essentially of the same nature as the cytoid bodies in gliomas and that I could not usually recognize them as different from the latter.

After reading the author's paper I am inclined to believe that, contrary to his opinion, the bodies really are of some diagnostic importance. For, if a tumor closely resembling a glioma contained numerous cytoid bodies, this fact would seem to be strong confirmatory evidence that it was truly a glioma. My chief interest in cytoid bodies lay in the fact, first demonstrated by me (although McLean gives me no credit for the demonstration), that the cytoid bodies found in the retina under certain pathologic conditions are identical in nature with the peculiar bodies often found in gliomas. It is known that under certain unknown conditions extravasated blood in the retina becomes white, and it seems probable that the blood under these conditions undergoes a change that gives rise to cytoid bodies. Just what these conditions are and what the change is require further investigation. McLean contributes nothing to the solution of this problem. In fact, he does not establish anything new of importance. He raises the question, already raised by me, as to whether cytoid bodies occur in other than glial tissue, but in my opinion he leaves the question still open.

F. H. VERHOEFF, M.D., Boston.

Abstracts from Current Literature

Aqueous Humor

THE COPPER CONTENT OF THE AQUEOUS. I. I. NITZESCU and I. GEORGESCU, Compt. rend. Soc. de biol. **117:** 1135, 1934.

In bovine eyes fresh from the abattoir the copper content of the aqueous averages from 0.147 to 0.188 mg. per liter, according to the chemical method of determination used. This value is comparable to that previously reported for horse serum. J. E. LEBENSOHN.

SUGAR CONTENTS OF THE AQUEOUS. KODAMA, Acta soc. ophth. jap. **38:** 66 (June) 1934.

The sugar content of the blood serum and of the aqueous of rabbits was examined. That of the aqueous was found greater than that of the blood, though definitely less than that of the blood serum. The sugar content of the second aqueous was at first increased and then gradually diminished. It was greater than the content of the blood serum. No influence of light on the sugar content of the aqueous could be determined. A relation between the ocular pressure and the sugar contents of the aqueous and blood serum was not confirmed. The sugar content of the blood serum was at first increased after an intravenous infusion of from 7 to 10 cc. of a 20 per cent solution of grape sugar. It then rapidly diminished, while the sugar in the anterior chamber did not reach its maximum until from thirty to sixty minutes after the injection, and then slowly diminished. In a definite time the amount of sugar in the aqueous was greater than that in the blood serum. The ocular pressure, which was at first reduced, then increased above the normal, and ultimately returned to the normal. A. KNAPP.

Biochemistry

THE POLYSACCHARIDE OF THE VITREOUS HUMOR. K. MEYER and J. W. PALMER, J. Biol. Chem. **107:** 629, 1934.

Meyer and Palmer have obtained a polysaccharide acid of high molecular weight from the vitreous humor of cattle. They have recognized as constituents a uronic acid, amino sugar and possibly a pentose. Redslob and Reiss (*Ann. d'ocul.* **166:** 1, 1929) found that the injection of an isotonic alkaline solution into the vitreous humor of the rabbit produces a long-lasting rise in intra-ocular pressure with all the other clinical symptoms of glaucoma. The present authors speculate as to the possibility of this polysaccharide acid producing a spontaneous alkaline reaction by the lactonization of the acid and the simultaneous liberation of the base which originally neutralized it. F. H. ADLER.

Conjunctiva

EPITHELIAL XEROSIS OF THE TARSAL CONJUNCTIVA. A. FERRARI, Arch. di ottal. **41:** 116 (March) 1934.

A case of an isolated patch of xerosis on one upper lid is reported. The patient was a woman of 65, the subject of trachoma since childhood. The affected area measured 4 by 6 mm. It was whitish, and the surface had a greasy appearance. A smaller patch was present on the bulbar conjunctiva. Various organisms, including Bacterium xerosis, staphylococci and diplobacilli, were found in smears and cultures. Inoculations of the material into animals gave negative results. The patches were excised and proved, on section, to be composed of squamous epithelium, the outer layers of which contained flattened and degenerated nuclei and keratohyaline granules. Ferrari believes that changes in the epithelium and in the composition of the tears due to trachoma were responsible for the condition.

S. R. GIFFORD.

Congenital Anomalies

BILATERAL FACIAL COLOBOMA WITH OCULOPALPEBRAL ADHESIONS AND OCULAR COMPLICATIONS. L. MAZZI, Arch. di ottal. **41:** 148 (March) 1934.

The internal third of each lower lid was replaced by a band of scar tissue extending down into the cheek and upward, that on the left side inserting itself into the lower portion of the cornea. On this side, the iris was adherent to the cornea just back of the insertion of the band. Vision was 2/10. Mazzi believes that an inflammatory process or mechanical pressure from the amniotic sheath prevented closure of the superior facial fissure. The adhesions between the lid and the globe, with apparently a perforation of the left cornea, are explained as due to secondary pressure from the amnion after the first process had occurred.

S. R. GIFFORD.

THE RELATIONSHIP BETWEEN PHOTOPHOBIA AND NYCTALOPIA. SHIMIZU, Acta soc. ophth. jap. **38:** 83 (June) 1934.

The vision of patients with albinism and aniridia who were suffering from corneal ulceration or iritis was examined under various degrees of illumination. Shimizu found that with increased illumination vision improved notwithstanding the unpleasant feeling which the additional light produced. In other words, the results were quite different from those found in diseases which produce nyctalopia.

A. KNAPP.

Cornea and Sclera

EPISCLERITIS ZOSTER (EPISCLÉRITE ZOSTÉRIENNE). L. GENET, Bull. Soc. d'opht. de Paris, June 1934, p. 344.

At the December meeting of the society in 1926 Genet reported the occurrence of episcleritis in the course of a zona ophthalmica. There existed a redness of the conjunctiva, diffuse and uniform, limited to a

protruding nodular crown outside the cornea, and lasting from eight to nine months without photophobia, lacrimation or pain. After a period the lesion turned slate gray. Another case was reported at the May 1927 *séance*. Genet now reports a third case seen in February 1934. The patient consulted him because of a slate-gray spot in the conjunctiva. She had had a herpes zoster two years and some months previously. The lesion and the slit-lamp findings are described in detail. Genet believes that the graying is a nutritive phenomenon. It is important to know of this condition so that one may differentiate it from a neoplastic growth.

L. L. MAYER.

BLUE SCLERAE AND FRAGILITAS OSSIUM. CASANOVAS, Arch. de oftal. hispano-am. **34:** 133 (March) 1934.

After a brief review of the literature on the relations between blue sclerae and fragilitas ossium and of the theories presented on its causation and on the influence of heredity, Casanovas reports a case in a boy 9 months old, with no hereditary antecedents and with four brothers in whom no such condition was found. This child was born at term after normal labor. He was fed first on condensed milk, then on cow's milk and finally on a farinaceous milk food. He was poorly nourished. The sclerae were very blue and the bones of the cranium excessively thin, with open communicating fontanels. There was clinical and x-ray evidence of consolidated fractures as follows: in the right clavicle, in four ribs on the right side and two on the left, in the two humeri (double on the right side), in the left ulna and radius, in the two femurs (double on the left side) and in the left tibia.

The child died of a gastro-intestinal complaint and an anatomico-pathologic examination of both eyes was made. This showed only excessively thin sclerae and marked uveal pigmentation, to which circumstances the blue color of the sclerae can be attributed.

C. E. FINLAY.

REGENERATION OF THE CORNEAL NERVES AFTER EXTRACTION OF A CATARACT. A. CHICHKANOVA, Sovet. vestnik oftal. **4:** 537, 1934.

Chichkanova made an extensive clinical and experimental study of the regeneration of the corneal nerves after an extraction of cataract. The sensitivity of the cornea was tested by Frey's method: A series of measured hairs was used and it was found that a hair with a maximal pressure of 1 Gm. was felt by the patient as a tactile sensation, while a hair with a pressure of 10 Gm. gave a sensation of pain. The cornea was divided by radii into seventeen touching points. The first testing of the cornea was done before the operation, the second ten days after the extraction, and the following ones once every month. Sixty-seven patients, aged from 50 to 70, were examined after operations for cataract, the periods of observation lasting up to two years.

The conclusions from the clinical study were as follows: 1. It is possible to cause a tactile sensation and one of pain of the cornea with measured hairs. 2. The threshold of sensitivity in old age corresponds to a hair with a maximal pressure of 1 Gm. 3. After extraction of a cataract the sensitivity in the upper half of the cornea is always impaired, and in about 40 per cent that in the lower half (opposite the

incision). 4. The restoration of sensibility is observed from the periphery to the center and vice versa. 5. The restoration of the sensibility of the cornea after extraction of a cataract takes from a few weeks to a few months.

In order to establish the connection between the clinical symptoms and the anatomic changes, Chichkanova made an experimental and histologic study of the cornea in forty rabbits, in each of which a corneal section was made similar to that for extraction of a cataract. Slides of normal corneas of rabbits were studied previously. She used two methods for staining the nerves: one in which osmic acid is used for the myelin fibers, and one in which silver is employed after Ramón y Cajal for myelin and nonmedullated nerve fibers. The technic of each method is described in detail.

The staining with osmic acid permitted the following observations on the myelin fibers: Degenerative changes of the fibers were noticeable on the third day after the severance of the nerves, as they appeared dark; at the end of the second week nearly all the myelin fibers appeared black. In seventy days after the operation the degenerative process began to diminish; the black myelin gradually disappeared, and at the end of the third month some of the nerve fibers appeared normal, although side by side with these were still degenerated fibers showing the presence of black myelin.

The microscopic slides of the corneal nerves stained by the silver method demonstrated distinctly the degenerative changes in both medullated and nonmedullated nerve fibers. The myelin sheath was abnormally impregnated with silver, and the axis-cylinders were in a state of degeneration and were divided into separate segments on the third day after the injury of the nerves. In thirty days the degeneration of the nerves reached its peak. In sixty-seven days there appeared nearly normal nerve fibers with only an excessive impregnation. About five months after the operation the regeneration of the nerve fibers was complete, and in only a few was there a slight excess of impregnation, without serious disturbance of the structure of the nerve fibers. With both methods, the changes of the nerves were observed also in the lower half of the cornea.

These are the conclusions from the experimental study: 1. The presence of degenerated nerves side by side with nerves of normal structure and staining in the upper half of the cornea, with correspondingly changed nerves in the lower half, indicates that there are anastomoses between the nerves of the upper and lower halves of the cornea. 2. About the third day after the severance of the nerves, degenerative changes appear; on the thirteenth day they reach their peak, and in sixty days there are still marked degenerative changes. 3. Complete regeneration of the nerves occurs within various periods. The shortest period was three months. 4. There was observed a certain similarity in regeneration of the corneal nerves after cataract extraction in the rabbit and the human cornea. It was impossible to establish a definite period of regeneration, as it varied widely. At times the regeneration was incomplete after a very long period.

O. SITCHEVSKA.

STUDIES OF DIFFUSE SUPERFICIAL KERATITIS. TAKEDA, Acta soc. ophth. jap. **38:** 65 (June) 1934.

There are two kinds of superficial keratitis: punctate and diffuse. Clinically, both are important. Diffuse superficial keratitis was described more fully by Professor Miyashita in 1917. Today, twenty years later, its cause is not yet clear. Takeda thought at one time that this disease must be related to a deficiency of vitamin B, as it occurs frequently in Japan and is often associated with axial neuritis. Further investigations have shown that this is incorrect. As vitamin B_2 (G) seems to exert a healing action on it, Takeda believes that the disease is due to a deficiency of this vitamin. Superficial diffuse keratitis does not often appear in persons with trachoma and conjunctivitis unless there is a deficiency of vitamin B_2.

A. KNAPP.

Experimental Pathology

THE DIFFERENT BEHAVIOR OF INFECTION AND REINFECTION OF THE ANIMAL CONJUNCTIVA WITH VARIOUS TYPES OF TUBERCLE BACILLUS. A. FERRARI, Arch. di ottal. **41:** 274 (June-Nov.) 1934.

Groups of eighteen rabbits and eighteen guinea-pigs were employed. Nine of each group were given subconjunctival injections of human, bovine and avian strains of the tubercle bacillus, three animals being employed for each strain, while nine of each group were infected with the same strains by instillation of cultures into the conjunctival sac after scarification of the conjunctiva. All animals given subconjunctival injections showed granulomas after from four to twenty days. Adenopathy occurred from the seventeenth to the twenty-fourth day in rabbits given injections or inoculations of any of the three strains, while in the guinea-pigs this occurred only after injections. After scarification only the human and bovine strains caused adenopathy. In guinea-pigs the human strains produced earlier and more severe lesions, while in the rabbits this was true of the bovine type. On inoculation of the bacilli into the opposite eye later, lesions occurred earlier and in nearly all animals. They did not differ in severity, however, from the lesions produced by the primary inoculation.

S. R. GIFFORD.

FRACTIONAL IRRADIATION OF THE RABBIT'S IRIS: REMARKS ON GOLDMANN'S BURNS OF THE IRIS AND CATARACT CAUSED BY HEAT. B. SEMADENI, Klin. Monatsbl. f. Augenh. **92:** 779 (June) 1934.

Semadeni renders an account of the research on infra-red irradiation of rabbits' eyes. He refers to Goldmann's report of infra-red irradiation resulting in burns of the iris and fundus in rabbits. Semadeni's recent experiments, which are described in detail, support Vogt's findings of 1912 and 1919, which were contrary to Goldmann's: 1. External heat of any intensity, with or without long wave infra-red rays, but void of *penetrating* infra-red rays, never produced a cataract unless other burns resulted in the external eye. (2) Cataract caused by furnace heat has never been observed clinically unless the lens was exposed to the influence of fire, i. e., to penetrating infra-red rays. Such a cataract cannot be produced by nonpenetrating infra-red rays, no matter

of what intensity. To support this statement, he refers to Josuran's experiments. The eyes can be protected against penetrating infra-red rays only by goggles with lenses containing ferrous oxide, which strongly absorbs these rays.

K. L. STOLL.

General Diseases

AN ATYPICAL CASE OF MIKULICZ' SYNDROME. M. MARQUEZ, Arch. de oftal. hispano-am. **34:** 513 (Oct.) 1934.

This is the report of a case of Mikulicz' syndrome with great tumefaction of both lacrimal glands, of some of the Krause glands, of the parotid glands, of some of the submaxillary salivary glands and of some of the labial glands. After excision with subsequent roentgen treatment, a satisfactory result was obtained. Histologic examination showed a lymphoid infiltration without a trace of glandular tissue. Marquez enters into considerations based on the anatomicopathologic observations in relation to the lymphoid infiltration and on the distant focal lesions which may have influenced its production or maintenance.

C. E. FINLAY.

OCULAR LESIONS IN EXANTHEMATOUS TYPHUS. R. COSTA LENNON, Arch. de oftal. hispano-am. **34:** 595 (NOV.) 1934.

After a brief review of the literature on the subject, Lennon reports the ocular lesions found in 131 cases of typhus in the active stage, which can be summarized as follows:

	Cases of Typhus
Exophthalmos	5
Subconjunctival hemorrhage	1
Pupillary disturbances	18
Choroiditis	5
Anterior optic neuritis	6
Cephalic arterial hypertension	30
Retinal edema with venous engorgement	All
Retinal hemorrhage	4

Reports of cases of typhus in which the different complications were encountered are attached, and the current views on the production of such complications are discussed. A greater proportion of these complications are observed during convalescence, owing to the greater facilities for their observation at that time and because the general prostration and severity of the general symptoms during the active stage call attention away from the ocular symptoms.

C. E. FINLAY.

OPHTHALMOLOGIC OBSERVATIONS ON ONE HUNDRED PATIENTS WITH MALARIA. A MOTEGI, T. KAN, S. KÓ and S. SYÚ, Klin. Monatsbl. f. Augenh. **92:** 797 (June) 1934.

The eyes of 100 Chinese patients, 4 of them women, suffering from malaria, were observed at the Laboratory of Experimental Therapy of Malaria at Taiwan, China, by Motegi and his assistants. The eyes were examined at the beginning and at the termination of the treatment and again eight weeks later. Quartan malaria existed in 20 patients;

tertian in 43; tropical in 30, and tropical coupled with quartan or tertian in 7. Ocular symptoms not resulting from malaria were found in 45 of the 100 patients on admission to the hospital. Vision, the width and reaction of the pupils, accommodation and the field of vision were not impaired by malaria. Changes in the fundus were noted in 54 patients: grayish-white edema of the retina in 19; small petechial arterial extravasations in 11; tortuous and distended veins in some; distended arteries in others, and "reddened" disks in 8. These changes occurred in 24 cases of tertian malaria, 17 of tropical and 9 of quartan. The hemorrhages were absorbed, leaving no trace of pigmentation, and the retinal edema disappeared promptly. In only 2 cases was severe optic neuritis observed. Positive Pirquet and Wassermann reactions and high blood pressure had no relation to the malarial changes in the retina. Yellowish discoloration of the conjunctiva of the globe occurred in 10 cases; it was coupled with a low percentage of hemoglobin and was probably due to decay of red blood corpuscles.

K. L. STOLL.

General Pathology

THE PATHOLOGY OF THE SO-CALLED IDIOPATHIC UVEITIS WITH DYSACOUSIA AND POLIOSIS. OGAWA, Acta soc. ophth. Jap. **38**: 68 (June) 1934.

It is known that idiopathic uveitis (the Harada'sche as well as the Vogt-Koyanagi type) is similar clinically to sympathetic ophthalmia, so that it seems probable that the anatomic differences between idiopathic uveitis and sympathetic ophthalmia have not been cleared up. Kitazawa, in 1927, described the histologic observations in a case of idiopathic uveitis with leukoderma, and concluded that the uveitis was different from sympathetic ophthalmia. Matsuoka, in 1933, examined histologically a piece of iris from a patient with uveitis, poliosis and leukoderma, and concluded that the uveitis was not only clinically but microscopically the same as sympathetic ophthalmia. Ogawa has examined the eyeball of a patient with the so-called idiopathic uveitis, a man 48 years old, which was removed on account of secondary glaucoma. The anterior chamber contained a large amount of blood. The iris was atrophic and diffusely infiltrated in places with round cells, and the vessels were obliterated. The ciliary body was moderately thickened, and a diffuse infiltration was everywhere present with dilatation of the blood vessels. The choroid showed similar changes in the layers of the medium-sized and large vessels, but was not thickened. The chromatophores in the outer layers of the choroid were diminished. The round cell infiltration consisted of lymphocytes, plasma cells and fibroblasts. There were no epithelioid cells or giant cells. The retina was fairly normal, and the degeneration of the pigmented epithelium was moderate. The optic nerve showed few changes. In short, these findings do not agree with those of the typical sympathetic ophthalmia. It must, however, be remembered that sympathetic ophthalmia is anatomically sometimes atypical.

A. KNAPP.

Glaucoma

INITIAL RESULTS OBTAINED IN ANTIGLAUCOMATOUS THERAPY WITH A NEW CALCIUM-MAGNESIUM COMPOUND. JEAN GALLOIS and P. VIARD, Bull. Soc. d'opht. de Paris, June 1934, p. 325.

The authors have spent three years in the experimental use of a complex calcium-magnesium compound to alleviate glaucoma. The formula consists of 0.8 Gm. of magnesium hyposulphite and 0.7 Gm. of calcium chloride in 10 cc. of isotonic salt solution. The combination has been used previously as an antispasmodic in general disease. The drug is given, on the average, three times a week by slow intravenous injection. The use of miotics is continued in the usual manner.

No appreciable modification of the iris and pupil follows the use of the drug. No modification occurs in the general arterial tension after one injection or after a series of injections.

After the injection the patient has a feeling of warmth; the face flushes, as also does the skin of the entire body; the disk becomes slightly hyperemic, and perhaps the retinal veins dilate. The respiratory movements are accelerated. In the normal eye the intra-ocular tension is lowered some millimeters. In the glaucomatous eye there is usually an immediate lowering of tension, rarely an elevation, the average change being from 3 to 5 mm. and at times 10 mm. The lowering of tension continues for several weeks after the final injection. In hemorrhagic glaucoma the injection gives a rise in tension, and the final results are mediocre. Thirteen cases are reported. There is a definite change in the hydrogen ion concentration of the blood following the use of the drug to as low as 5.2. The theoretical point of view is discussed in this preliminary communication. L. L. MAYER.

THE INFLUENCE OF TENOTOMY OF THE RECTUS MUSCLES ON INTRA-OCULAR TENSION IN GLAUCOMA. I. M. SAPIR, Sovet. vestnik oftal. **5**: 382, 1934.

Since the anterior ciliary arteries are located in the recti, Sapir believes that tenotomy of these muscles including the severing of blood vessels will aid in decreasing the production of intra-ocular secretion. He tenotomized all of the recti on twenty-four eyes of twenty glaucomatous patients. Of these patients, two suffered from acute inflammatory glaucoma, one from hemorrhagic, five from chronic inflammatory, four from chronic simple and ten from absolute glaucoma. In all but three cases the intra-ocular tension was lowered from 12 to 48 mm. The maximal lowering of tension was observed from two to five days after the operation. The tension increased again to the preoperative height in four patients in a few months after the operation, but they had no more attacks. In four cases vision increased in the eye operated on from 0.4 to 0.9; in the others the vision was not improved.

The complications observed were hemorrhages from the severed arteries. In one case hemorrhage caused exophthalmos and transitory loss of vision because of the compression of the optic nerve. In the few cases in which vision was present in both eyes diplopia was observed because of displacement of the eye. In order to prevent this condition Sapir suggests that one do an incomplete tenotomy, leaving 1 mm. of

each muscle undivided at the periphery. Further observations are necessary to confirm his idea that the decrease of the intra-ocular tension in tenotomy of the recti is due to the decrease of blood volume in the uveal tract.

O. SITCHEVSKA.

Injuries

SEQUELAE OF A TRANSFIXED WOUND OF THE ORBIT BY A FRAGMENT OF SHELL: TRAUMATIC CHORIORETINITIS OF THE RIGHT EYE AND OPTIC ATROPHY OF THE LEFT EYE. P. BONNET, Bull. Soc. d'opht. de Paris, June 1934, p. 347.

The patient was wounded in 1918 in the Somme. A piece of howitzer shell entered the left temple and forced its way into the right orbit, whence it was extracted after some months. The wounded man was entirely blind for a month but finally recovered a little vision in the right eye. The patient consulted Bonnet because of a blur in the right eye for some weeks. The picture in the fundi was typical of that seen after a suicidal attempt in which the revolver is placed over the temple. Bonnet wishes to know whether the pigmentary disturbance is due to hemorrhage or to a migration of retinal pigment. A discussion is included in the article.

L. L. MAYER.

Instruments

A NEW TREPHINE FOR KERATOPLASTIC SURGERY. R. FRIEDE, Arch. f. Augenh. **108:** 568, 1934.

Friede describes a mechanical trephine similar to the von Hippel instrument but with the following improvements: It is 37 mm. long, whereas the von Hippel instrument is 52 mm. long. It weighs 44 instead of 73 Gm. The instrument is easier to hold than the von Hippel, and the manipulation of the clockwork is more simple.

F. H. ADLER.

Lens

COMPARATIVE END-RESULTS IN THE INTRACAPSULAR AND EXTRACAPSULAR OPERATIONS FOR THE REMOVAL OF SENILE CATARACTS. D. K. PISCHEL, Am. J. Ophth. **17:** 326 (April) 1934.

After making a study of the records of the First University Eye Clinic of Vienna, Pischel states the following conclusions: "While the results in the successful intracapsular operation are practically as good as those in the well-performed extracapsular operation, there were more bad results even in a selected series of cases of intracapsular operations than in an unselected series of extracapsular operations."

W. S. REESE.

ELASTOMETRIC MEASUREMENTS OF ANIMAL LENSES. K. VOGELSANG, Arch. f. Augenh. **108:** 565, 1934.

Vogelsang attempts to measure the elasticity of animal lenses by the method of ballistic elastometry. The method is briefly outlined, and two illustrations are given of the type of records obtained. The protocols show alterations in the tension of the lens caused by postmortem changes and by opening the lens capsule.

F. H. ADLER.

Lids

THE OPERATION FOR PTOSIS AFTER BLASKOVICS: REPORT OF CASES. K. LINDNER, Klin. Monatsbl. f. Augenh. **93:** 1 (July) 1934.

Lindner compares the operation for ptosis after Blaskovics with those after Hess, Motais and Everbusch. He gives a clear and detailed description of the operation, illustrated by eleven drawings of its consecutive steps. He adds a report of twenty cases in which twenty-four eyes were operated on. Among these cases were two of ptosis after paralysis and injury, respectively, one of congenital ptosis and one of ptosis following scrofulous inflammation. Lindner is greatly satisfied with the results obtained since he began operating after Blaskovics' method. A repetition of the operation on the same eye is difficult, owing to the scar formation resulting from the first operation. Lindner thinks a second operation may be avoided by a correct use of the test suture. The cosmetic result was superior to that yielded by other operations for ptosis. The raised and furrowed forehead noticed after Hess' method never developed after Blaskovics'. The lids retained their normal lines and aspect; the dents in the margin of the upper lid observed after Motais' method were absent. The cosmetic results were satisfactory even in severe congenital ptosis.

K. L. STOLL.

GENERAL IMMUNIZATION IN BLEPHARITIS AND ECZEMA OF THE LIDS. A. YAKOVLEVA, Sovet. vestnik oftal. **5:** 234, 1934.

Yakovleva used autovaccination successfully in twenty-one cases of stubborn blepharoconjunctivitis in which routine treatment was of no avail. About ten injections were made subcutaneously under the clavicle at the rate of one every three days, beginning with 0.1 cc. of the vaccine and increasing the dose by 0.1 cc. at each injection. In one patient with marked eczema of the lids and brows and thickening of the lids the treatment gave little improvement, while in all others with combined eczema of the lids and of the skin of the face autovaccination gave lasting results.

Yakovleva also tried a stock vaccine made of from ten to fourteen strains of staphylococci, five to six strains of Corynebacterium xerosis, three strains of streptococci and three strains of pneumococci. Sixteen patients were treated with the stock vaccine. The results were not as favorable as with autovaccination. The bacteriologic findings in forty-four patients suffering from blepharoconjunctivitis are listed in detail.

Conclusions are drawn by Yakovleva as follows: 1. General autovaccination in blepharoconjunctivitis gives good results in patients who do not respond to ordinary therapy. 2. The autovaccine should be made of both the cutaneous and the conjunctival microbes. 3. The dosage should be carefully individualized. 4. Recurrence is rare and is caused by a change of the flora, i. e., by a new infection. 5. Improvement with the use of stock vaccine was observed mostly in cases of abscesses and phlegmons.

O. SITCHEVSKA.

Methods of Examination

THE ACTION OF DI-ALLYLOXYETHYL-DI-PHENYL AMIDINE HYDROCHLORIDE IN INCREASING EYE TENSION. WHAT IS THE BEST ANESTHETIC TO USE IN TONOMETRY? H. SCHMELZER, Ztschr. f. Augenh. **83:** 331 (July) 1934.

Di-allyloxyethyl-di-phenyl amidine hydrochloride was recommended by Lüssi in 1924 as a local anesthetic which causes only slight discomfort after instillation into the eye and which is without influence on the pupil, the mechanism of accommodation or the blood vessels. After employing it satisfactorily for two years in tonometry, Schmelzer observed two patients with compensated glaucoma who in quick succession suffered acute attacks of glaucoma after its use. Experimental instillation in normal eyes of a number of students seemed to show that the drug is not without some dilatant effect on the pupil. Schmelzer now favors the use in tonometry of a 1 per cent solution of p-n-butylaminobenzoyl-dimethylamino-ethanol hydrochloride followed by a 0.1 per cent solution of pilocarpine.

H. L. BEGLE.

Neurology

AMAUROSIS AND HYSTERICAL AMBLYOPIA. P. DUPUY-DUTEMPS, Bull. Soc. d'opht. de Paris, June 1934, p. 278.

Dupuy-Dutemps reports in detail two interesting cases of hysterical blindness. The subsequent investigation into the family history and background of each of the patients leaves nothing to be desired in the finding of a basis for the condition. The literature on this type of case is extensively reviewed, and an abundant alphabetical bibliography is appended.

L. L. MAYER.

OPTIC-CHIASMIC ARACHNOIDITIS WITH TOTAL BLINDNESS; INTERVENTION; AMELIORATION. BAILLIART, DAVID and SCHIFF-WERTHEIMER, Bull. Soc. d'opht. de Paris, June 1934, p. 293.

A man of 45 years had an infected lower left molar tooth removed in August 1933. One month later there were pain and a sensation of fulness on the left side of the face. During a severe seizure of pain the patient noticed that he saw double, especially when looking to the left. In the middle of October the vison of the left eye was reduced, and a paralytic convergent strabismus of the left eye ensued. In January 1934 pain persisted, the vision of the left eye was entirely lost, while the visual acuity of the right eye was normal. In February complete anosmia was noted. In March the patient had a violent cold with intense headache. The right eye began to fail, and by the end of the month complete blindness was present. The authors then saw the patient for the first time. The right fundus showed a mild papillary hyperemia, veins slightly dilated and arteries normal, with a retinal tension of 80. The left eye showed a white disk of the primary type. The pupils were fixed in mydriasis. The oculomotor nerve to the left eye was completely paralyzed. There was a hypesthesia of the left cornea. Neurologic examination revealed no further signs or symptoms.

The past history included a severe attack of grip in 1932. The question of a Foster-Kennedy syndrome arose. Roentgen examination of the cranium disclosed nothing relative. A neurosurgical investigation revealed an inflammatory mass in the region of the chiasm with a gelatin-like exudate covering the nerves. The left optic nerve was markedly reduced in size. Eight days after operation the patient counted fingers at 25 cm. with the right eye. Later a hematoma called for a reopening of the wound. Examination nine months after the original symptoms revealed normal peripheral fields and a vision of 1/50 for the right eye. The retinal arterial tension was 45. The left eye showed no recovery.

L. L. MAYER.

EYE SYMPTOMS OF PARKINSONISM IN JAPAN. ITOH, Acta soc. ophth. jap. **38**: 80 (June) 1934.

In Europe, attacks of oculomotor crises are regarded as characteristic of parkinsonism, but in Japan they are seldom observed, while a central scotoma with changes of the fundus and contraction of the visual field is frequent in Japan but uncommon in Europe. The condition of the visual field may be explained by the fact that beriberi is a malady with central scotoma but generally without peripheric contraction. It can scarcely be assumed, however, that all of the cases are complicated with beriberi. Intoxications with tobacco and alcohol, as well as multiple sclerosis, are unusual in Japan. Diseases of the nasal sinuses can be excluded. At the same time one must be cautious in regarding these symptoms as characteristic of parkinsonism in Japan. It may not be impossible that the central scotoma has escaped the usual careful examinations of the European investigators. For determining these symptoms, Itoh recommends the use of the scotometer of Komoto.

A. KNAPP.

Operations

EXPERIMENTAL KERATOPLASTY. KIYAMA, Acta soc. ophth. jap. **38**: 64 (June) 1934.

At corresponding places in both corneas in the eyes of two rabbits round epithelial defects were made of the same size and depth. In one eye tissue juice of a chicken embryo or aqueous from the anterior chamber was instilled. In this eye, as opposed to the other eye, in both cases, the epithelial regeneration was successful. Then a partial nonperforating keratoplasty was done, and the second aqueous, which was rich in fibrin, was instilled on the area to be transplanted, so that the transplant could adhere. Then a mixture of aqueous and tissue juice from the chicken embryo was instilled, and the transplant grew fast to the floor without becoming cloudy. During the healing fluorescein was instilled, and no epithelial injury was discovered. Foreign bodies, such as pieces of hair, were left between the transplant and the floor and remained unchanged. A histologic examination of the transplant showed that all layers were well preserved, and that the lamellae of the corneal tissue remained parallel. Kiyama thinks that his obser-

vations in immunologic investigations with vaccine virus are important. On transplanting the cornea of a healthy rabbit to a rabbit immunized with vaccine virus, the transplant retained its sensitivity to the vaccine virus. On transplanting the cornea from a rabbit immunized to vaccine virus to the cornea of a healthy rabbit, the transplant showed a distinct difference in the immunized response to its surrounding tissue. Kiyama thinks that he has succeeded in showing that a corneal transplant can be transplanted without dying, and that a true keratoplasty exists.

A. KNAPP.

Orbit, Eyeball and Accessory Sinuses

A CASE OF TUBERCULOUS PANOPHTHALMITIS, WITH CONSIDERATIONS OF THE PRIMARY LOCALIZATION. Y. KOYANAGI, Klin. Monatsbl. f. Augenh. **93: 37** (July) 1934.

A woman, aged 32, with a positive Wassermann reaction, had panophthalmitis of one eye followed by spontaneous perforation of the sclera. A secretion oozing out of the perforation contained tubercle bacilli in an abundance resembling that of a pure culture. No other micro-organisms were found after inoculation of rabbits' eyes or in the eyeball, the histopathologic observations on which are given in detail. The most striking features were acute purulent inflammation with necrosis of the detached retina, considerable hyperplasia of the choroid and typical tuberculous changes of the iris and ciliary body. In reference to the attempt to find the primary lesion in the eyeball, Koyanagi mentions a visual defect of the nasal half which had occurred suddenly prior to admission to the hospital. A moderate detachment of the retina had been observed there at that time. The anamnesis and histopathologic observations prompt Koyanagi to the opinion that the primary disturbance was an acute tuberculous choroiditis, accompanied by detachment of the retina. The iris and ciliary body became involved soon afterward. Reactive proliferation of the tissues followed, but was insufficient to limit the affected area. The slow progress of the disease, consuming one month from the onset up to the time of the perforation of the sclera, is typical of tuberculosis. Destruction of tissues, apparently in the area of the ora serrata, led to involvement of the vitreous body. This was followed by extensive development of the germs. A fresh purulent inflammation in the retina and also in the uvea resulted, whence, assisted by the preexisting proliferative changes, the disease involved the sclera, and the perforation occurred. K. L. STOLL.

Physiologic Optics

THE RELATIONSHIP OF THE TWO FOCAL DISTANCES OF THE EYE. DUFOUR, Bull. Soc. d'opht. de Paris, March 1934, p. 191.

Dufour shows by a diagram that the relationship of the two focal distances of the eye is as that of the indexes of refraction of the extreme media. Formulas and figures are cited to prove this contention.

L. L. MAYER.

Refraction and Accommodation

THE INFLUENCE OF ACETYLCHOLINE ON ACCOMMODATIVE SPASM. A SANTONASTASO, Ann. di ottal. e clin. ocul. **61**: 881 (Dec.) 1933.

Santonastaso tried the effect of acetylcholine in cases of myopia, reasoning that its relaxing effect on smooth muscle might affect the accommodative spasm which often reduces distant vision in myopes. One-tenth gram was injected subcutaneously daily for from six to eight days. Within this short time, visual acuity increased in some of the young myopes, and the near point receded 1 to 3 cm. In other types of refractive error, especially in hyperopia, a much greater effect on the near point was observed (a recession of 24 cm. in one case).

The author gives reasons for believing that this is not due to the vasodilation produced, but to a selective stimulation of the longitudinal fibers of the ciliary muscle (tensor choroideae of Brücke) and to a relaxation of the circular fibers. He thinks such an effect continued over long periods may be of benefit in progressive myopia, in which ciliary spasm is known to be a factor.

S. R. GIFFORD.

ASTHENOPIA. HAGIWARA, Acta. soc. ophth. jap. **38**: 57 (June) 1934.

The relative amplitude of accommodation and convergence is definite but under certain conditions may be altered. During the measurement of the relation of accommodation to convergence, there is an area where the vision is clear and easy, situated within the two curves of the relative amplitude of accommodation and of convergence, which the author calls the region of comfortable vision. Patients with normal vision, with variations in refraction and with muscular anomalies were examined with the haploscope. In emmetropia this "comfortable" zone coincides with the so-called Donders' convergence line. In esophoria it is to the right of this line; in exophoria, to the left. To determine the near and far points in the relative amplitude of convergence, the arms of the haploscope are rotated, and the degree of convergence is determined by finding the place where the fused visual objects become indistinct and separate into two pictures. If one continues to fix the objects which have become indistinct, after a short time the objects again become clear. If the degree of convergence is increased, the experience is repeated, and the relative amplitude of convergence is gradually enlarged. In other words, this can be used as an exercise to enlarge the relative amplitude of convergence and the rapidity with which the convergence can be separated from the accommodation.

The author examined a number of patients with asthenopia and found that those with slight exophoria or orthophoria who possessed good convergence power exhibited no weakness of accommodation and were therefore to be regarded as neurotic. For these patients the described exercises were used in order to dissolve the association of convergence and accommodation. This led to a lengthening of the convergence amplitude, and as the rapidity of separating convergence and accommodation was increased, the asthenopic symptoms disappeared. Hagiwara believes that the good effect of muscular exercises lies not so much in the strengthening of the muscles and of the fusion power as in the separation of the convergence from the accommodation. In his cases

he found that the recovery from asthenopia depended on measures which easily broke up the association between convergence and accommodation, and thinks that these exercises should be used in cases of obstinate asthenopia. In myopias of middle degree, asthenopia depends on the exophoria, which can be determined better by measuring the relative convergence amplitude with the haploscope than it can with the Maddox rod. The relative amplitude of convergence has a tendency to become smaller after correction of the myopia. A. KNAPP.

Retina and Optic Nerve

A MODIFIED ELECTRO-DIATHERMIC TECHNIC FOR RETINAL DETACHMENT. E. B. GRESSER, Am. J. Ophth. **17:** 340 (April) 1934.

Gresser discusses the various methods used for curing detachment of the retina and gives the following summary:

"Following Guist's method of a complete ring of adhesions at the retinal periphery, but obtained with the high-frequency current, six eyes with retinal detachment were operated upon.

"In three cases, poor results were obtained, in one of which firm vitreous presented and apparently prevented apposition. In one case, immediate improvement resulted but lasted only 17 days while in another seven weeks elapsed before the retinas redetached. No opinion is offered on these cases. In the remaining three cases improvement in vision followed reattachment and at the end of six weeks still persists.

"Withdrawal of subretinal fluid is apparently an essential procedure.

"A modified nonrusting electro-magnetic 2-mm. needle and its accompanying holder is presented, offering the advantages of simplicity, ease, and effectiveness of manipulation. The certainty of piercing into the subretinal space with these needles obviates the necessity of trephining. Furthermore, as tamponage is obtained at the same time, moderate care precludes false operative starts." W. S. REESE.

EMBOLI AND SPASM OF THE CENTRAL ARTERY OF THE RETINA. H. TILLÉ and J. HÉRY, Bull. Soc. d'opht. de Paris, June 1934, p. 290.

The interpretation of the symptoms in the case presented was found difficult, but the value of certain vasodilators makes it of interest. A woman, aged 38, noted in looking at people that their heads were missing. Visual acuity in the right eye was 0.4; in the left, 1. The field of the left eye was normal, but the entire superior half of that of the right was obliterated, and a large annular scotoma and a small central scotoma of 2 degrees existed. The right fundus appeared practically normal. Only on detailed study was it noted that the inferior arterial branch was attenuated in caliber and straighter than the superior. The inferior part of the retina presented a number of islets of dimly appearing capillaries. A black spot the diameter of a vessel was noted on the disk in the branching of the central artery into its inferior limb. The disk showed some loss of color. General examination revealed a congenital mitral lesion with evidence of active pulmonary tuberculosis. Five injections of acetylcholine in amounts of 0.2 Gm. enhanced the vision

from 0.4 to 0.8. The superior nasal quadrant of the visual field did not return. A photograph of the fundus and studies of the visual fields accompany the article.

L. L. MAYER.

RESEARCH ON THE DISTURBED HUMORS IN DETACHMENT OF THE RETINA (PRELIMINARY NOTE). JEANDELIZE, DROUET, VÉRAIN AND BAUDOT, Bull. Soc. d'opht. de Paris, June 1934, p. 300.

The urea, cholesterol, calcium and sodium chloride contents of the blood of twenty-one patients with detachment of the retina have been studied for one year.

Large tables compare the findings in normal persons with those in the twenty-one patients with detachment. The detachments were classified as to cause in the following manner: (1) spontaneous, 10 cases; (2) due to indirect trauma, 5 cases; (3) due to direct trauma, 4 cases, and (4) occurring in connection with extraction of a foreign body, 2 cases.

The urea content varied from 0.25 to 0.62 Gm. In seven of fourteen cases it was normal, in two subnormal and in five slightly above normal. The extreme variation would seem to indicate that examination for urea is unimportant. Cholesterol was below normal in all except two of fifteen cases. The calcium values varied from 75 to 150 mg. and lend little to the investigation.

The chloride determinations were divided into those for the blood cells and those for the plasma. In eleven of twenty cases the chloride in the cells was increased, in four normal and in five decreased. The variations of the chloride in the plasma were considered in relation to the causes of the detachments. In six of ten cases of spontaneous detachment the chloride was raised either in the plasma or the cells. Four of the five cases due to indirect traumatization showed an increase in chloride. In the four cases due to direct trauma the figures varied too greatly to be conclusive. This was also true of the group due to extraction of foreign bodies. Totalization showed retention of chloride in 65 per cent of the cases examined.

The conclusions are: 1. The variations in urea content are unimportant. 2. The cholesterol level is generally lowered. 3. The calcium level varies more or less, with a tendency to hypocalcemia in the spontaneous rupture (77 per cent). 4. The chloride content seems most important, as a retention was found in 73 per cent of the cases.

L. L. MAYER.

MYELIN FIBERS OF THE RETINA. BONNET and BLANC, Bull. Soc. d'opht. de Paris, June 1934, p. 336.

This article consists of a demonstration and report of two areas of myelinated fibers in the right eye of a young man. The one, in the form of a white triangle, was located at 2 disk diameters from the disk along the superior nasal vein. The other, at a distance of 3 disks diameters, was found below. The disk was normal. There was no lesion in the left eye. The visual acuity was normal, with scotomas representing the myelinated areas. Neurologic examination revealed nothing of importance. There was no hereditary history of note. The literature is briefly discussed.

L. L. MAYER.

ENDOVASCULITIS AND PERIVASCULITIS OF RETINAL VESSELS. PAULINA SATANOWSKY, Arch. de oftal. de Buenos Aires **8:** 44 (Jan.-Feb.) 1933.

A case is reported in which there was gradual loss of sight in one eye for five years. White connective tissue projected into the vitreous from the papilla. Pearly white striae followed retinal vessels from the papilla to the periphery of the retina; others terminated in the retina somewhat beyond the margins of the disk. The clinical and biologic observations and information as to tuberculous antecedents, existence of diabetes, septic foci and syphilis were negative. The only similar case which Satanowsky has been able to find record of in the literature is Meyer's, reported by Leber.

Satanowsky observed a case of syphilitic origin in which after a thrombosis of the central retinal vein a white spot formed at the macula.

C. E. FINLAY.

SURGICAL TREATMENT OF OPTIC NERVE ATROPHY. RICARDO MOREA, Arch. de oftal. de Buenos Aires **8:** 71 (March) 1933.

The chiasm and the optic nerves may be the seat of variously originated lesions which permit a correct localization. These may be brought about through compression by a tumor, through persistent intracranial hypertension and through inflammation of the arachnoid enveloping the optic nerves and chiasm. The factor of arachnoid inflammation is the subject of this paper. Knowledge of cases with such an origin dates back only two or three years, although prior to this patients with this type of lesion had been successfully treated by operation without recognition of the lesion. The first patient operated on with a prior correct diagnosis was one of Balado's, in 1928. Similar cases in which other Argentines operated and subsequently cases in which others in different countries operated were later reported.

Morea describes at length the anatomic conditions at the chiasm with relation to the arachnoid sheath, which is here separated from the chiasm and the optic nerves by an appreciable space filled with cerebrospinal fluid. Pathologic examination of excised arachnoid from patients operated on shows a spindle cell new formation of membrane.

The inflammation may be due to irritation by a tumor with prior production of inflammation of the meningeal sheath and secondary optic neuritis followed by atrophy; to acute and chronic inflammation of the brain and meninges, often syphilitic, to other infectious processes and to diabetes.

The visual fields present various findings, and a distinguishing feature is the existence of field defects without deformation of the sella turcica.

The treatment consists in opening the arachnoid sheath after its exposure by the temporal or transfrontal approach.

Morea reports ten cases with clinical findings and gives a description of the operation and the results.

C. E. FINLAY.

THE ETIOLOGY OF COATS' RETINITIS EXSUDATIVA. P. JUNIUS, Klin. Monatsbl. f. Augenh **92:** 748 (June) 1934.

Junius discusses the etiology of Coats' exudative retinitis in connection with an article of J. Marshall and J. C. Michaelson (*Tr. Ophth. Soc. U. Kingdom* **53:** 102, 1933) and with the view of other authors since Coats' publication in 1908. Junius found that a congenital atavistic predisposition exists in the three types of generalized telangiectasia, and that only a small group of persons are subject to this disease. Miliary aneurysms of the small blood vessels of the retina appear to be an equivalent of the telangiectasias. Aside from the rare miliary aneurysms in exudative retinitis, an analogy occurs: changes in the small vessels which favor hemorrhages akin to "hereditary hemorrhagic telangiectasia." This seems to be a physicochemical anomaly.

Great consideration is given the reports of cases by Harry Friedenwald and his views, with which Junius agrees. The controversies between Leber and Coats wane since "exudative hemorrhagic retinitis with multiple aneurisms" may be considered as the base of Coats' exudative retinitis. Coats' theoretical contention that the disease is congenital has been proved to be correct as a result of recent research. Typhoid fever and syphilis, as reported by Friedenwald, and other diseases may further the development of these retinal changes, which, however, occur in the absence of complications, even in small children. The combination of glaucoma and miliary aneurysms of the retina is deserving of further research.

K. L. STOLL.

A MODEL FOR EXPERIMENTING ON DETACHMENT OF THE RETINA. A. VON RÖTTH, Klin. Monatsbl. f. Augenh. **93:** 47 (July) 1934.

An annular opacity, i. e., a dehiscence of the vitreous in front of the disk, had been observed by a number of writers. Rötth noticed it in only 3 per cent of cases of over 8 diopters of myopia, but observed it in about one third of cases of primary detachment of the retina. He also recorded the observation that dehiscence of the vitreous preceded as often as it followed detachment of the retina. He therefore thinks that certain cases of primary detachment occur thus: The peripheral portion of the retina and the vitreous degenerate on a myopic and senile base. Dehiscence of the vitreous follows. As a consequence of the motion of the eye, the detached and floating glassy membrane will pull at the area between the ora serrata and the equator, to which it is normally well attached. Any degenerated portion in this area is liable to tear. Traction toward the anterior segment of the globe can exert itself without an obstacle. Some force acting from the rear toward the front of the globe is suggested by the form of the flap, with the apex toward the disk and the base toward the ora serrata. The glassy membrane, moving and exerting a traction after dehiscence of the vitreous, plays a rôle in a certain percentage of retinal detachments. To prove this, Rötth devised a model consisting of a bottle of 1 liter content and a neck of a diameter of 3 cm. lined with a layer of gelatin 2 mm. in thickness. It resembles the model of Lindner.

K. L. STOLL.

FIXATION OF THE GLOBE IN THE TREATMENT OF DETACHED RETINA. H. ARRUGA, Klin. Monatsbl. f. Augenh. **93:** 52 (July) 1934.

After surgical treatment of detached retina it is imperative to keep the eye at perfect rest. Immobilization of the globe is more essential than rest of the patient's body. Lindner devised his spectacles with this aim. Weekers injected 1 cc. of a solution of oxycyanate (1:500) into each of the four straight eye muscles. Arruga inserted a suture through the inferior rectus and the lower lid, including its tarsus. The globe regained its motility, however, after from three to four days, even when the suture had been well placed. More secure fixation was obtained by pulling the suture through perforated pieces of celluloid or metal, over which the suture was tied outside the lid.

A retrobulbar injection of from 5 to 9 cc. of the patient's own blood must be repeated after from two to three days. Its effect, however, can be prolonged by the addition of 1 drop of 90 per cent alcohol or from 1 to 3 drops of a solution of mercury cyanate (1:1,000) or of a solution of ethyl morphine hydrochloride (1:100) to each cubic centimeter of blood. Immobilization lasting for several weeks may be obtained. In Arruga's cases motility always returned.

K. L. STOLL.

HISTOPATHOLOGIC EXAMINATION OF AN EYE AFTER GONIN'S OPERATION. E. LEVKOEVA, Sovet. vestnik oftal. **4:** 567, 1934.

This is the third case reported in the literature in which histopathologic observations were made on eyes after Gonin's operation. The changes described here are not typical for operations on retinal detachment, because of the severe complications which followed the operation. A woman physician, aged 40, was operated on by Lindner for a retinal detachment in an eye with 14 diopters of myopia. Gonin's operation was performed in 1929 three times within two months with no favorable results. The eye became irritated a few months after the operation. The eye was enucleated in Moscow within fifteen months after the operation.

Macroscopically the eyeball was markedly atrophic. There were three operative scars with corresponding depressions, one horizontal, at the lower nasal quadrant and two perpendicular to the first one. The microscopic changes were as follows: In the sclera there was an oblong depression to which the conjunctival epithelium was adherent so that it had the appearance of a channel. There were also particles of pigment adherent to the sclera from the suprachoroid. The channel was directed toward the equator of the lens and ended there in thick scar tissue. This organized connective tissue evidently pulled the lens to the spot where galvanocautery was done. Near the scarred walls of the channel the sclera was in a state of necrobiosis; the fibers were edematous; the nuclei stained very little, and it was distinguished from the normal sclera by its structureless appearance. A part of this sclera was directed toward the ciliary body. The ciliary muscle adjacent to this section was markedly atrophic, and the ciliary processes were destroyed.

In the suprachoroid the pigment of the chromatophores and pigment epithelium penetrated the channel of the operative scleral scar. The suprachoroid and choroid took part as histogenous elements in the formation of scar tissue on the surface of the retina at the points of adhesion. At the point of galvanocautery the choroid and pigment epithelium were ruptured, and liquid rich in cholesterol penetrated the perichoroidal space and the scleral tissue. The whole uveal tract presented old and fresh inflammatory processes. Round cell infiltration and lymphocytes were seen in the iris and choroid. The localization of these near the pupillary margin and in the choroid at the operative points indicated that this inflammation was of a reactive and not of a sympathizing character. At two points where the sclera was perforated, the choroid was either destroyed completely with only a trace of pigment left or it was flattened, while at some places it was replaced by connective tissue.

Most of the retina was detached, deeply wrinkled and protruded loosely into the intra-ocular space. The retina was attached only at two points by a thick connective tissue band. To one of these, at the pars planum of the ciliary body, the retina was adherent to the lens. The retinal tissue at places was destroyed or had lost its structure and was transformed into a thin glial membrane. The retina was torn away near places of evidently too firm adhesions. Hemorrhages could be traced to those spots. At some places the retinal tissue showed actual traces of a burn.

Levkoeva stresses these points: 1. Too much electrocoagulation was done. This led to the injury and burn of the sclera, choroid and retina. 2. The severe operative intervention caused, instead of a flat adhesion of the retina, a "rushing" to the perforation, resulting in the formation of retinal folds and their adhesion to the place of perforation, also the tearing of the retinal tissue. 3. One of the operations was performed too near the ciliary body, and the course of the galvanocautery was too much forward, so that the injury to the lens occurred.

O. SITCHEVSKA.

INTRACRANIAL PRESSURE AND BLOOD PRESSURE IN THE CENTRAL RETINAL VESSELS. IMACHI and KODOMARI, Acta soc. ophth. jap. **38:** 72 (June) 1934.

Intracranial pressure, which plays so important a rôle in the clinical diagnosis of nervous diseases, can generally be readily determined by lumbar puncture. In some cases, however, lumbar puncture cannot be carried out. Baurmann recently stated that spontaneous venous pulsation excludes a pathologic increase of pressure within the cranial cavity. Bailliart, on the other hand, said that an increase in the blood pressure in the retinal arteries may be of importance in the diagnosis of an increase of intracranial pressure. In order to determine the relation between the cerebrospinal pressure and the blood pressure in the retinal vessels, the authors have made clinical examinations and have made experiments on rabbits. Before and after lumbar puncture, the pressure of the spinal fluid and that of the blood in the central retinal blood vessels were measured. In the rabbits, the changes in the blood pressure in the retinal vessels were studied after the intracranial pressure

had been artificially increased by the injection of Ringer's solution. In the clinical observations the determinations of blood pressure were made with the Bailliart ophthalmodynamometer. The mercury manometer was used for the rabbits. The results were as follows: In the clinical investigation, the blood pressure in the retinal vessels was in no relation to the intracranial pressure and changed quite irregularly after lumbar puncture. In the rabbits, the artificial increase of the intracranial pressure produced an increase of the diastolic arterial pressure and of the venous pressure in the retina, but the arterial and venous pressure did not reach the same height as the intracranial pressure. The authors therefore believe that the blood pressure in the retinal vessels may be increased in pronounced increase of intracranial blood pressure but does not show a parallel change. Hence, intracranial pressure cannot be determined definitely by measuring the blood pressure in the central vessels of the retina.

A. KNAPP.

Trachoma

THE STRUCTURE OF HERBERT'S PITS. A. BUSACCA, Compt. rend. Soc. de biol. **117:** 715, 1934.

As a result of histologic study, Busacca concludes that the pits of trachoma described by Herbert are not pits, but an appearance due to an optical illusion. In the early stage of trachoma, the nodules at the limbus destroy the superficial layers of the sclera and thrust laterally the new-formed blood vessels that proceed to the cornea. During pannus formation these nodules are resorbed, and their space is filled with proliferated epithelium. As the scleral fibers do not regenerate, the observer now sees at these spots through the replacing epithelial cells transparent corneal lamellae. The vessels that previously surrounded the nodules become transformed into white strands and give a festooned border to the so-called pits.

J. E. LEBENSOHN.

TRANSITORY AND PERMANENT PTOSIS IN TRACHOMA. A. BUSACCA, Rev. internat. du trachome **11:** 204 (Oct.) 1934.

Mild ptosis may follow mechanically from increased weight of the upper lid, but the pronounced types are myopathic in origin and result from trachomatous involvement of the muscle of Müller and the distal extension of the levator. Should the inflammatory process in these muscles end in destructive changes, a permanent paralytic ptosis will result even though the trachoma itself is eventually cured.

J. E. LEBENSOHN.

TRACHOMA IN THE UNITED STATES. J. MCMULLEN and C. E. RICE, Rev. internat. du trachome **11:** 227 (Oct.) 1934.

Trachoma is endemic in a zone extending through the middle of North America from the Alleghanies to the eastern borders of Kansas and Oklahoma. The incidence in this area is from 4 to 17 per thousand. Diagnostically, the corneal involvement is most significant. Epidemiologically, American trachoma is essentially familial, and school trachoma

is negligible. Trachoma is frequent in professional wrestlers, and in some of them has appeared after a single bout.

Of 8,444 patients in Kentucky, 463 were blind, and 840 had vision of 20/200 or less. In Missouri, about 12 per cent of the patients had vision reduced to 20/200 or less.

American trachoma seems to be on the decline. In eastern Kentucky, trachoma affected 17 per thousand in 1915, and but 7 per thousand in 1930. In Missouri, a rate of 28 per thousand in 1923 was found reduced to 22 per thousand in 1930.

J. E. LEBENSOHN.

Tumors

CANCER OF THE EYE AND ITS TREATMENT. H. VASSILIADIS, Arch. d'opht. **51:** 348 (June) 1934.

This report comes from the Cancer Institute of Louvain. Vassiliadis points out the necessity for determining the origins and invasive characteristics of neoplasms of the eye. Epithelioma of the lid is briefly referred to. Cancers of the soft tissues of the globe are considered in two groups, the first consisting of tumors of the conjunctiva at the limbus and the second of tumors of the iris, ciliary body, choroid and retina. Tumors of the orbit are separately considered. In regard to treatment he advocates the use of radium, a therapy which he believes superior to any other for neoplasms of the lid. For superficial tumors of the globe he advocates either roentgen or radium treatment. With more deeply situated tumors radiotherapy combined with surgical operation is necessary. He reviews the results in twenty-six patients observed from two to eight years after treatment. Cure resulted in 53 per cent. He believes that surgical removal combined with radiotherapy is the best form of treatment for these conditions.

S. B. MARLOW.

EPITHELIAL INVASION OF THE ANTERIOR CHAMBER. A. HUDELO and HERMANN, Arch. d'opht. **51:** 356 (June) 1934.

Two cases are reported, with photomicrographs constituting the chief anatomic descriptions. On the basis of these two cases the clinical conclusions drawn are that traumatism, accidental or operative, is necessary for the invasion to occur, that something must be included in the wound, that the filling of the iris angle with epithelium and the formation of a cyst are not two phases of the same process, and that glaucoma is not an inevitable complication. The authors suggest that it would be of value to study the iris angle in serial sections in cases of epithelial invasion in which glaucoma occurs. Mechanical glaucoma and the drainage rôle of the iris angle could be determined in such a study.

S. B. MARLOW.

DIAGNOSIS OF SARCOMA OF THE CHOROID IN A REPORTED CASE. H. ARRUGA, Arch. de oftal. hispano-am. **34:** 377 (July) 1934.

A patient who had normal vision showed a small peripheral defect in the visual field and a limited peripheral retinal detachment, which had seemingly not progressed for several months and which showed

a distinct elevation of 4 mm. (12 diopters). Diaphanoscopy with Guist's lamp and Lange's lamp gave positive results, with pupillary darkening only when the lamp was placed over the site of the detachment. After enucleation by Meesmann, a pathologic examination confirmed the existence of a small, limited melanosarcoma of the choroid with cellular polymorphism.

Arruga stresses the peculiar points of normal vision, lack of pain, reaction or hypertension and slow development over several years. The opinions of Fuchs, Morax and Schieck on like cases made the determination to enucleate difficult to accept.

C. E. FINLAY.

LYMPHOSARCOMA OF THE LIDS AND LACRIMAL SAC. L. CROCI, Lettura oftal. **11:** 3 (June) 1934.

A woman 55 years of age noted swelling of the right superior cervical region. Within three months the swelling extended to the right eyelids and later involved the left lower eyelid and the lacrimal sac. A mass was present in the pharynx on the right side. Biopsy showed lymphosarcoma. Under roentgen therapy the swellings at first decreased, but later returned to their former volume and did not respond to further treatment. A nodule appeared on the left leg, and when the patient left the clinic this nodule was increasing in size. Examinations of the blood showed no important changes.

A bibliography and photomicrographs accompany the article.

S. R. GIFFORD.

Uvea

POSTVARIOLAR CHANGES IN THE IRIS. A. RUSSO, Ann. di ottal. e clin. ocul. **6:** 923 (Dec.) 1933.

Having observed changes in the iris of a patient twelve years after smallpox which resembled those described by Löwenstein and Alajmo, Russo examined thirty-three former subjects of smallpox. Sixteen, or 48.5 per cent, showed such changes. Characteristic were areas of atrophy in the stroma of the iris, which were deprived of pigment, the atrophy affecting the ciliary and sphincter portions alike. Atrophy of the trabeculae of the iris was also frequently observed, and there was more or less disturbance of pigment all through the stroma of the iris. The patients were, as a rule, young adults in whom senile pigmentary changes could not be expected. Round excavated areas of atrophy of the type present most markedly in two cases had previously been described as affecting the ciliary portions alone. These lesions cannot be considered as analogous to the pustules of the skin, but seem to represent the effect of toxic products reaching the iris through the blood stream. The trabecular atrophy and the dispersion of pigment granules in the superficial stroma affected chiefly the ciliary portion of the iris. In thirteen cases deposits of pigment were present on the capsule of the lens. The subjects chosen for examination were those in whom no clinical signs of ocular involvement and particularly no signs of keratitis had been observed during the disease.

S. R. GIFFORD.

Vitreous

BIOMICROSCOPIC ASPECTS OF THE VITREOUS IN APHAKIC EYES. P. GIOVANNI, Ann. di ottal. e clin. ocul. **61:** 904 (Dec.) 1933.

Forty cases of aphakia were studied at various periods after the removal of the lens. Only those with a normal postoperative course were included. The details of eleven cases are given. Changes in the fibrillar structure of the anterior surface of the vitreous were observed, and the postoperative changes, especially the prominence of oblique or horizontal fibers, could be distinguished from the usual senile vitreous changes. Two kinds of pigment were found in the vitreous: blood pigment, which disappeared within the first few weeks after operation, and uveal pigment, which remained for several months or longer. Prolapse of vitreous into the anterior chamber was observed in only one case: A thread of vitreous extended forward to an attachment on the cornea. In other cases, white deposits on the corneal endothelium were thought to represent degenerated fragments of vitreous substance detached from their original location. Immediately after operation the retrolenticular space was abolished, but after several weeks a clear space was reformed between the capsular remains and the anterior surface of the vitreous.

S. R. GIFFORD.

THE CAUSES OF OCULAR SYMPTOMS AND VITREOUS OPACITIES IN SPIROCHAETOSIS ICTEROHAEMORRHAGICA. UENO, Acta soc. ophth. jap. **38:** 79 (June) 1934.

It is not understood whether the vitreous opacities in this disease are due to the action of spirochetal toxins or to the action of bacteria which have not been killed by the immune bodies. Ueno has investigated this question and finds that after rabbits have received injections of a liver emulsion from guinea-pigs suffering from spirochetosis they show the same reaction as with bacterial toxins. Immune bodies are present in both the anterior chamber and the vitreous. The spirochetal toxins do not appear in the anterior chamber or in the vitreous before ten days. The various tissues of the eyes of the diseased guinea-pigs presented only a few spirochetes. This shows that the various symptoms as well as the vitreous opacity can be traced to the action of bacterial toxins.

A. KNAPP.

Therapeutics

THE VALUE OF SULPHUR PYROTHERAPY IN SOME OPHTHALMIC DISEASES, ESPECIALLY THOSE OF NONSYPHILITIC ORIGIN. A. FERRARI, Arch. di ottal. **41:** 127 (March) 1934.

The literature on the production of fever for therapeutic purposes by injection of sulphur is reviewed. Intramuscular injections of 2 cc. of a solution containing 0.0005 Gm. of colloidal sulphur were given at the rate of one every two to three days. From four to eight injections were usually given. From four to five hours after an injection, the

temperature rose, reaching 39.5 C. after from eighteen to twenty hours. It became normal after from thirty to thirty-six hours. This rise was most marked after the first injection, less so or absent after later ones. No severe reactions or complications were observed. In chronic glaucoma no effect on tension was seen. In episcleritis, scleritis and rheumatic iritis good effects were observed, and also in serpentine ulcer, interstitial keratitis and postoperative cyclitis. In most of the cases of postoperative cyclitis, the treatment was apparently of great value, a rapid decrease in symptoms being noted after the first few injections. Two patients with tabetic optic atrophy were treated. In one, vision improved from 5/10 and 2/3 to 10/10 in each eye, with some increase in the fields. In the second patient, improvement was less marked: from 4/10 to 5/10 in each eye.

S. R. GIFFORD.

Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Oct. 18, 1934

J. MILTON GRISCOM, M.D., *Chairman*

A. G. FEWELL, M.D., *Clerk*

OPTIC ATROPHY DUE TO THALLIUM POISONING. DR. J. B. RUDOLPHY.

Mrs. M. R., 38 years old, consulted me on Sept. 6, 1934, complaining of poor vision. In January 1930, she began to use Koremlu cream, a cold cream having depilatory properties and containing thallium acetate (7.18 per cent). She applied this cream to her face before retiring, allowing it to stay on all night and often throughout the day. She continued this practice for fourteen months. After six or seven months of this routine, she suffered a nervous breakdown and was admitted to a hospital in her home city. Her symptoms at this time were extreme nervousness, pain in all limbs, gastric pain, vomiting and "a sort of stiff feeling" in her extremities, as well as weakness and fatigue. She continued to use the cream in the hospital, and while she was there her hair fell out, and her vision became blurred.

When she was first seen by me on Sept. 6, 1934, her vision was: right eye, 1/60; left eye, 1/60. For about one year she had been taking sodium thiosulphate, with benefit to her general condition. External ocular examination showed moderately dilated pupils with but slight reaction to light and in accommodation. Ophthalmoscopic examination showed the media clear, the disks of a peculiar gray-green color and surrounded by some choroidal pigment, and the vessels normal; there were no discrete lesions.

The patient was referred to Dr. M. J. Cooper for neurologic examination, and on September 10 she was admitted to Dr. T. B. Holloway's service for further study. While she was at the Hospital of the University of Pennsylvania her visual fields were taken by Dr. Wentworth. They showed slight contraction with a cut in the superior temporal quadrant and large absolute scotomas just above and including the line of fixation. She did not recognize red. The blood and urine were normal, as was the Wassermann reaction of the blood. The blood pressure was 160 systolic and 115 diastolic. X-ray photographs of the pituitary region and of the sinuses revealed no changes.

DISCUSSION

DR. M. J. COOPER: From the neurologic standpoint, the history and the objective findings in this case indicated central and peripheral involvement of a moderate degree. A few weeks after the onset of the first gastro-intestinal symptoms, there were muscular weakness,

ataxia and pains diffusely felt throughout the trunk and all four limbs, with great tenderness of the soles. There was distinct anxiety with changes of personality in the acute stage, although no frank psychosis occurred. The neurologic examination on September 6 showed no distinct impairment of mentality or of voluntary power in resisted movements, though the patient showed both mental and physical fatigue rather readily. The gait, station and coordination were about normal except for a little dysdiadokokinesis in the left hand. There was great depression of the reflexes of both upper limbs and of the epigastric and abdominal reflexes, while the patellar and achilles reflexes were moderately exaggerated. The Babinski response was with plantar flexion of all the toes. There naturally arose the question of differentiating between thallium poisoning and other conditions, particularly multiple sclerosis, which might produce a similar neurologic picture. A lumbar puncture was done. The initial cerebrospinal fluid pressure was 110 mm. of water; the Queckenstedt test was negative; the fluid contained 5 cells and 27.2 mg. of protein per hundred cubic centimeters and gave a negative Wassermann reaction and a colloidal gold curve of 4444443210. Multiple sclerosis was, of course, not ruled out by these findings. However, in view of the history, the apparent regression rather than progression of the neurologic symptoms since the onset four years previously, and the clinical picture suggesting the residua of damage to the peripheral and central nervous system at a prior date, I agree with Dr. Rudolphy in his opinion that thallotoxicosis was the primary condition.

DR. O. L. MUNCH: Thallium is used on a large scale for the control of rodents, especially west of the Mississippi River. In early studies, it was found to be toxic, and an antidote was developed for thallium poisoning in experiments on animals. However, there was no need to use this antidote until January 1932, when 14 persons were poisoned with thallium following the consumption of tortillas made from thallium-treated grain. Six of these patients refused treatment, and all 6 died; 8 accepted treatment, all 8 lived. These results appear too good to be true, but they have at least confirmed the method, an account of which has been published (Ginsburg, H. M., and Nixon, C. E.: Thallium Poisoning: A Preliminary Report of Eleven Cases at the General Hospital of Fresno County, California, *J. A. M. A.* **98:** 1076 [March 26] 1932).

DR. J. V. KLAUDER: It may be interesting to know that dermatologists use thallium in order to epilate the scalp in the treatment of ringworm in children. The matter of the proper dose is very important (1 mg. per kilogram of body weight in a single dose given orally). Its administration is contraindicated above the age of 12. At puberty severe toxic symptoms may appear; hence the drug is not employed at this period. It is apparent that the drug is better tolerated by children.

DR. WILLIAM ZENTMAYER: Experiments on animals appear to have given contradictory results. Swab found that in rats the lens was the only structure of the eyeball that was not affected by thallium; round cell infiltration was found elsewhere in the tissues of the eye. Douski found, however, that if rats were fed thallium with their food, anterior and posterior cortical opacities appeared in the lens. If the thallium was withdrawn no further opacities developed, but those formed were pushed toward the nucleus by new-formed lens fibers. If the feeding with thallium continued, total cataract resulted.

PARTIAL DETACHMENT OF THE RETINA TREATED WITH SURGICAL DIATHERMY. DR. H. MAXWELL LANGDON.

In the *Transactions of the American Ophthalmological Society* for 1924, Post reported that the application of the thermophore at a temperature of 160 F. for one minute brought a definite reaction in the sclera and the underlying choroid. Wheeler, at a meeting of the American Academy of Ophthalmology and Otolaryngology, suggested that the thermophore might be of help in detachment of the retina; and Crisp, in an editorial in the *American Journal of Ophthalmology,* expressed the same idea, but apparently neither of the two had attempted to prove this theory.

In August 1919, Mr. D. J. C., 22 years old, was seen on account of loss of vision of the right eye, which had been failing for about eight months. It was found that the retina was almost completely detached, with vision of 1/60. This was believed to be the result of trauma, as he had boxed a great deal while in the navy during the war. At that time, the left eye had normal vision. In September 1927, he was seen again on account of some blurring of the left eye. It was found that there was a partial detachment of the lower outer portion of the retina, vision being 5/10. He had badly infected teeth and also badly infected tonsils. He was placed in bed, the tonsils were removed, and the teeth were extracted, and the retina returned to its proper position, the vision remaining 5/9 partly.

In August 1934, he again complained of blurring of the eye, and it was found that the retina was again detached in the same location. He was sent to the hospital; a conjunctival flap was made, and a sclerotomy was done, followed by an application of the thermophore to the sclera for one minute at a temperature of 160 F. The retina was found in place forty-eight hours later, when the dressings were changed. There it remained for two weeks, when it was again found detached as at first. The following day the operation was repeated, this time the temperature being 165 F.; the reaction was greater and the results so far have been good, the retina remaining in place with a full field and vision still 5/9.

DISCUSSION

DR. T. B. HOLLOWAY, Philadelphia: Dr. Langdon's case is extremely interesting. Until the development of recent operative procedures, all ophthalmologists regarded cases of this type as practically hopeless. I am convinced that the electrocoagulation method has been the most successful of the newer procedures. I am not certain whether Dr. Langdon made one application or a series, but I presume the latter. I prefer the Walker to the Šafář needles. I should like to see the thermophore successful in cases of this type; it is an ingenious and useful instrument, but, to be successful, it must produce a choroidal focus of inflammation.

DR. EMORY HILL, Richmond, Va.: I have had no experience with the thermophore in the treatment of retinal detachments, but I have tried several other methods. The Gonin method has proved entirely successful. I have used the Guist method eight times in 6 patients with three satisfactory results, one of which, unfortunately, was not permanent. The other 2 patients have had perfect results for over two years. The diathermic treatment has been used in my service at the Medical

College of Virginia in 4 cases recently. In the first of these a perfect result has been maintained for over two months; the patients in 3 more recent cases are still at the hospital. Two of them appear to be cured. The third was operated on last week; it is too soon to make any statement about the result.

MALIGNANT ANTHRAX EDEMA. DR. A. S. ROSS and DR. J. S. SHIPMAN.

A case of malignant anthrax edema is reported. A brief summary is given of the occurrence, the bacteriologic findings, the clinical appearance, the diagnosis and the treatment of this condition, and a detailed report is given of a case in which the right eyelids were chiefly involved. Pictures are shown of the various stages in the development of the condition. The treatment consisted chiefly in the administration of 740 cc. of antianthrax serum, both intravenously and intramuscularly. The patient made a complete recovery, with no disfiguring scars and with no impairment of vision.

DISCUSSION

DR. D. J. BOON: About twenty-five years ago, I saw 2 cases of anthrax; one occurred in a wool-sorter, and the other in a man who looked after horses at a country club. They presented exactly the same picture as Dr. Shipman showed, and they progressed until there was a puffiness of the mouth and throat, followed by suffocation and death. Anthrax serum was not known at that time.

BINOCULAR COLOR FUSION IN PATIENTS WITH WEAK VISION OF COLOR. W. C. BEASLEY, PH.D., R. H. PECKHAM, PH.D., and DR. R. C. MOORE.

None of the 75 patients studied showed previous symptoms of weak vision of color, but 87 per cent showed some weakness under the sensitive test conditions. Tests of their ability to fuse two macular-sized colored spots in the stereoscope indicated that 48 per cent were able to fuse some of the colors, 15 per cent may have fused them without experimental proof, and 37 per cent may not have fused the colors. In this manner, it was demonstrated that some color fusion is possible. The distribution of the data indicates a tetrachromatic two-process color theory, not a three color theory. These colors are paired as follows: red-green and yellow-blue. The greatest weaknesses were found in vision of red and green. The existence of binocular color fusion, under the test conditions, requires an acceptable color theory to include some central mechanism for the fusion. Purely retinal theories become inadequate to explain the data.

FEVER THERAPY FOR INTERSTITIAL KERATITIS. DR. JOSEPH V. KLAUDER and DR. HAROLD ROBERTSON.

In 1917 Wagner von Jauregg reported the results of treatment of patients with dementia paralytica by inoculation with malaria. His studies were motivated by the well known psychiatric observation that patients with psychoses are benefited by intercurrent infection. Fever therapy is now universally employed in the treatment of neurosyphilis, especially in that of dementia paralytica. The latter condition is arrested

and clinically "cured" in about 33 per cent of patients inoculated with malaria, and improvement is obtained in another 33 per cent. Fever is not employed in the treatment of other manifestations of syphilis. Recently, it has been utilized in the therapeusis of interstitial keratitis.

Malarial inoculation of patients with interstitial keratitis is not practical. It is not advisable to inoculate very young children with malarial parasites. Negroes are usually immune to malaria. Patients inoculated require from three to four weeks' hospitalization. Intravenous injections of mixed typhoid and paratyphoid vaccine produce too severe a reaction for use in the treatment of ambulant patients. Fever therapy by electrical methods requires elaborate apparatus and trained personnel. Typhoid H antigen was selected as the ideal agent for use in fever therapy. After an intravenous injection, the constitutional reaction is not pronounced, so that ambulant patients may be treated.

Typhoid H antigen was employed in the treatment of 30 children with active interstitial keratitis attending Wills Hospital. The youngest patient was 6 years of age. The injection was given intravenously, starting with 0.1 cc. and usually increasing the dose 0.1 or 0.5 cc. at each injection, depending on the reaction and fever produced by the previous dose. An injection was given every second or third day. One hour after the injection a chill appeared, lasting usually about one-half hour; the temperature rose from 102 to 104 F., becoming normal in from six to eight hours. In exceptional cases the fever exceeded 104 F. and lasted longer than eight hours. Patients in the hospital as well as those attending the clinic were treated. No serious untoward reaction was produced. In order to obtain a good rise in temperature, the double injection method was employed: At the height of the fever caused by an injection, a second injection of one-half the amount was administered. This second injection was given usually from two to three hours after the first. By this procedure, temperatures of 104 F. were obtained.

Antisyphilitic treatment was administered to all patients during the time typhoid H antigen was employed. Different lots of typhoid H antigen varied in their potency to produce reactions, and different patients varied in the degree of reaction to the same lot of vaccine.

Nov. 15, 1934

J. MILTON GRISCOM, M.D., *Chairman*

A. G. FEWELL, M.D., *Clerk*

SOME CASES ILLUSTRATING OBSTRUCTION OF THE RETINAL VESSELS. DR. T. B. HOLLOWAY.

The etiology and the signs and symptoms of obstruction of the central artery and its branches are alluded to in this paper, and emphasis is placed on the coagulation necrosis of the retina and visible streaming. The latter phenomenon is present in about 25 per cent of the cases.

One of the 6 case histories presented concerns a woman aged 39 years. She noted misty vision on arising, and was examined some four or five hours later. The nasal portion of the disk was slightly swollen;

the upper, nasal and lower borders were blurred. There were hemorrhagic streaks along the nasal border of the disk and along the vessels near the disk. Delicate linear hemorrhages were present along the temporal border. A macular artery bordered by an area of ischemic necrosis coursed outward above the macula. The veins, especially the superior temporal ones, were markedly engorged. Vision equaled 5/45. Four days later, there was an astonishing improvement: not only was the disk much less involved, but the veins were markedly reduced. Nine days after onset, the disk was flat, the veins were of normal size, the hemorrhages were nearly absorbed, and the necrotic area was less marked. Thirteen days after the onset, the only remaining changes were a slightly milky necrotic area and faint traces of one or two hemorrhages. Nineteen days after the onset, vision was 6/6. This measure of vision persisted, and the only fundus change remaining was a small stippled patch above the foveal reflex. A small scotoma persisted below the line of fixation.

In another case, the patient was 49 years old. There had been no recent illness, and the retinal vessels appeared normal for his age. The day prior to his coming for examination, he noted a spot before the right eye. Vision in the right eye was 5/22. The fundus presented the typical appearance of an obstruction of a macular artery coursing below the macula. In three branches visible streaming was observed. The blood chemistry was normal. Three weeks later, the signs of the necrosis had disappeared, and vision was 6/5 minus. A small scotoma above the line of fixation persisted.

Bilateral Congenital Deficiency of Abduction with Retraction (Duane Syndrome): Report of a Case. Dr. Willard G. Mengel.

This article is published in full in this issue of the Archives, page 981.

Short Studies on the History of Ophthalmology: Sir Jonathan Hutchinson, the Greatest "Generalized Specialist," and His Contributions to Ophthalmology. Dr. Burton Chance.

This article will be published in full in a later issue of the Archives.

Blindness in Onchocerciasis. Dr. Judson Daland.

Onchocerciasis is an endemic, progressive disease, with occasional exacerbations and remissions, occurring at all ages and in both sexes, and the duration may be twenty or more years. The cause of this disease is Onchocerca caecutiens, and millions of the worms are in the skin, but none in the blood. The sole transmitter is a female coffee-fly (Simulium), which in a few days converts a microfilaria into a young adult.

The disease occurs among Indians or residents on coffee plantations, and is restricted to an altitude of from 1,200 to 4,200 or more feet (365 to 1,280 meters), corresponding to the region occupied by the fly. The estimated number of cases of onchocerciasis in Mexico and Guatemala is 50,000 or more, and the disease is slowly spreading. The diagnostic findings in the order of importance are: microfilariae; tumors, 97 per cent located on the head; eosinophilia, averaging 37 per cent; thicken-

ing and swelling of the ears and eyelids and of the skin of the face; conjunctivitis; mild or intense photophobia; impaired vision or loss of vision; keratitis; iritis, and choroiditis. The percentage of cases of partial or total blindness varies in different localities in Mexico, Guatemala and Africa. The average of 10 per cent is much increased after the fifth year of the disease. Onchocerciasis frequently coexists with malaria, dysentery, ascariasis and infestations with pinworms and tapeworms.

The symptoms and lesions of onchocerciasis are chiefly due to the presence and movements of the parasite, and in my opinion are also in part due to toxins produced by the adult worms and to the products of the metabolism or of the dissolution of dead microfilariae.

Many authors have observed, after excision of the tumors, a sudden lessening of the photophobia, of the impairment of vision, of the dysfunction of the iris and of the mental confusion and auditory hallucinations, together with a diminution in the number of microfilariae and eosinophils. Excision of all tumors is followed by arrest of the disease. Prophylaxis is economically impossible. Treatment by drugs is unsatisfactory. The microfilaria of a similar disease in Northwest Africa is morphologically and clinically identical with that of the American disease. This communication is based on the study of 50 cases of onchocerciasis in Guatemala.

DISCUSSION

DR. DAMASO DE RIVAS: This disease has for many years been known to exist in Central and North Africa. The parasite, originally described as Filaria volvulus and later as Onchocerca volvulus, inhabits the skin of the chest, back, arms or head, and gives rise to a swelling or tumor. The embryo or microfilaria has been found in the subcutaneous tissue but not in the peripheral blood. The observation by Dr. Daland of the finding of the parasite in the eye, and particularly in the optic nerve, in Mexico and Guatemala is, I think, of exceptional interest. This finding has led American writers to regard the parasite found as a new species, but whether this is justified or not can be determined, I believe, only by further studies. It may be of interest in this connection to note that Dr. Richard P. Strong, in his recent expedition to Africa, noted an infestation of the eye by the African parasite.

Dec. 20, 1934

J. MILTON GRISCOM, M.D., *Chairman*

A. G. FEWELL, M.D., *Clerk*

COMMENTS CONCERNING OBSTRUCTION OF THE RETINAL VEINS. DR. T. B. HOLLOWAY.

The symptoms, signs and complications to be noted after obstruction of the central vein or its branches are reviewed, and attention is called to the edema of the disk. In many cases, if one could eliminate all of the fundus except an area the width of the disk immediately surrounding this structure, it would be impossible to differentiate edema of the disk

from the early choking noted in association with tumor of the brain. While the site of the obstruction is usually just behind the lamina, one should not lose sight of the possibility that the site may be posterior to this—a possibility referred to by Mickel and Yamaguchi and illustrated by Paton and Holmes and later by Fry. Certain of the theories advanced as to the cause of the frequently observed secondary glaucoma are enumerated.

DISCUSSION

Dr. William Zentmayer: I believe no mention was made of the varying degrees of hemorrhagic extravasation seen in these cases. In some instances, the entire retina is saturated with blood, whereas in others there are disseminated hemorrhages. This variation is probably due to the different degrees of obstruction and also to the variation in the weakness of the heart's action. In branch thrombosis, which, as Dr. Holloway said, is usually in the superior temporal vessel, though the retinal lesions are restricted, the damage to vision is often as great as in obstruction of the central vein, as the hemorrhages spread into the macular area and disturb the central vision. The life tenure in many of these cases is good, the patients living from six to twelve years after the development of the ocular trouble.

Dr. H. Maxwell Langdon: About five years ago, in a short period of time, I saw 3 cases of thrombosis of the central vein of the retina in each of which there developed an acute rise in tension. Later, in each of these cases a moderate rise of tension developed in the fellow eye; in other words, the eye which did not have the thrombosis acquired a simple, chronic glaucoma. It then appeared possible that increased tension presented itself in an eye which had had thrombosis of the central vein, but which had previously had a tendency to increased tension. I, therefore, took the tension in every case of thrombosis of the central vein as soon as I saw it and invariably found the tension well within the normal limits in both the affected and the unaffected eye, showing that there must be some secondary development to produce the increased tension which so frequently follows this condition of the retinal vein.

Nerve Messages from Sense Organs. Mr. D. W. Bronk.

Modern biophysical methods have made possible new and fruitful investigations of the peripheral mechanism of sensation. By recording the action potentials in single sensory nerve fibers, it is possible to intercept the sensory nerve messages from the individual receptors and thus to determine the nature of the nervous effects which give rise to sensation and to analyze the properties of the receptors. Of special interest to the ophthalmologist is the recent application, by Hartline, of these methods to single photoreceptors in the retina of vertebrates.

The characteristic sensory nerve message is a train of impulses following one another at a definite frequency. The variables in this message which signal variations in intensity of the stimulus are the number of sense organs in action and the frequency of impulses from the single receptor. Thus, the stronger the stimulus the greater is the number of receptors stimulated, inasmuch as those with higher threshold are then brought into action. Moreover, the stronger the stimulus the higher

is the frequency of discharge from the individual receptor. This frequency, however, is not constant for any given intensity of stimulus but gradually declines with time. This, therefore, accounts, at least in part, for the phenomenon of adaptation. On the basis of these results it is now possible to say that the intensity of sensation is, in general, a function of the total number of afferent impulses going into the centers.

If these sensory nerve messages from various sense organs are all of essentially the same general character, the very important question arises as to what is the afferent basis for different qualities of sensation. There are, it is true, certain important differences in the nervous discharge from different types of receptors. For instance, the tactile receptors adapt very much more quickly to a constant stimulus than do the photoreceptors in the eye. Nerve impulses coming from different types of receptors have somewhat different time constants. And the thresholds of different sense organs are quite different for the various types of stimuli, as is shown, for example, by the fact that some photoreceptors are very much more easily stimulated by certain wavelengths of light than are others. But probably the most important factor in this matter of discrimination of qualities is where in the central nervous system the afferent impulses finally end. Because of this consideration one must assume that the whole pathway is involved in determining the character of the results.

Such objective methods for the study of the sensory pathways offer tremendous possibilities for future investigations in ophthalmology and otology.

ORTHOPTIC TREATMENT OF CONCOMITANT SQUINT. JACOB B. FELDMAN.

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Jan. 17, 1935

J. MILTON GRISCOM, M.D., *Chairman*

A. G. FEWELL, M.D., *Clerk*

A CASE OF HOLE AT THE MACULA. DR. A. G. FEWELL.

J. S., a man 35 years of age, came to my clinic at the Pennsylvania Hospital in April 1933. He gave a history of having had the left eye injured by a blow from a piece of cast iron five years previously. Immediately following the blow, vision in this eye was blurred, and it has been gradually getting worse. Vision in the eye is 6/60; there is a typical oval hole at the macula about ¼ disk diameter in size. There is no other lesion of the fundus.

Vision in the right eye is 6/6, and the fundus is normal.

IRIDESCENT CRYSTALS IN THE CRYSTALLINE LENS. DR. ALFRED COWAN.

The patient, 86 years of age, has been under observation for the past two years, and the condition of the lenses has remained practically

unchanged during this time. The corneas are perfectly clear except for arcus senilis. The irides are generally atrophic, especially near the pupillary border, with slight ectropion uveae.

In a zonular arrangement in the adult nuclei and probably in the infantile nuclei, there are in each lens a great number of highly refractile, brilliantly colored, tabular crystals. The central portion of each lens is clear. There are also some senile changes, a few subcapsular vacuoles and some small opacities in the cortices. There are no abnormalities in the fundi except a sclerosis of the retinal arterioles. By retro-illumination and with the ophthalmoscope it is seen that the opaque bodies in the cortices are not opaque but refractile. It is felt that the condition represents a crystalline change that has taken place in the opacities of what formed, at one time, a zonular type of nuclear cataract. Vision in each eye, with correction, is 6/15.

DISCUSSION

DR. WILLIAM ZENTMAYER: Through the courtesy of Dr. Cowan I saw the patient. With the single exception of coralliform cataract it is the most spectacular lens condition that I have ever seen. As Dr. Cowan has said, a few crystals are frequently observed in many types of cataract, but it must be rare to have such masses of crystals present in the lens. In coralliform cataract, the opacity is also crystalline, but the crystals are not iridescent. In a case of mine, Dr. Verhoeff confirmed his previous study that these crystals are of protein origin. In a recent paper on ocular crystals, Duggar referred to crystals in the lens and pointed out that among other conditions they are observed principally in cataract from thyroid insufficiency, myotonia atrophica, mongolian idiocy or trauma and in hypermature cataract. In all of these conditions the crystals are usually iridescent.

ANKYLOBLEPHARON AND SYMBLEPHARON CORRECTED BY EPIDERMAL GRAFTS WITH SILVER CONFORMER. DR. GEORGE H. CROSS.

N. C., a white boy 13 years old, poured some molten lead into a pipe with wet mud or water at the bottom, on Nov. 26, 1932. The resultant explosion produced severe burns of both the right and left eyelids and eyeballs. Following this, despite treatment, symblepharon and ankyloblepharon formed and prevented free rotation of both the right and left eyeballs. On the right eye, there was a large growth of hyperplastic tissue which extended from the outer surface of the right lower eyelid across the cornea and involved the upper and lower eyelids and the cornea.

The first step in the operation was to make a number of silver conformers about 0.018 cm. thick, of the proper size and shape to fit in between the eyeball and the lids. These were made and hammered into a shape which was slightly larger than the normal eyeball so that the graft could be carried well back into the culdesac. They were beveled where they were cut out to allow free motion of the cornea. This opening was about 15 mm. in diameter. For this particular case, several different conformers were made, as there were no means of telling in advance just what size would be needed. A thin epidermal graft was removed from the inner side of the thigh, wrapped around the conformer with the raw surface on the outside, and then inserted in the culdesac.

The excess of graft tissue was allowed to extend out between the lids, completely covering the lid margin and partly covering the external surface of the eyelids. The eye was covered with warm Kerr's modeling compound and bandaged. At the end of five days the conformer was removed from the culdesac, leaving the graft, which covered the denuded surface of the eyeballs, lids and external lid surface. Later the excess of graft tissue was removed. After allowing the eyes to become perfectly quiet an iridectomy was performed, corresponding with the clear part of the cornea, which was at the temporal side in each eye. The vision in the left eye is now 50 per cent normal.

PRISM EXERCISES FOR FUNCTIONAL INSUFFICIENCY OF THE OCULAR MUSCLES. DR. LEIGHTON F. APPLEMAN.

Muscle training is important in the presence of weakness in convergence. When patients suffer from asthenopic symptoms, there are three factors which must be taken into account for their relief: (1) correction of the refraction under a cycloplegic in patients up to a certain age; (2) estimation of the vertical muscle imbalance, if present, and its correction in the glasses prescribed; (3) estimation of the convergence power which, if deficient, should be strengthened by exercises.

In correcting the third factor, the patient should be seated 20 feet (6 meters) distant from a point of light. Starting with prisms of low degree, bases out, placed in a temporary frame lowered in front of his own glasses, he fuses the images, and repeats the maneuver as many times as possible in a period of five minutes twice a day. The strength of the prisms should be increased at weekly intervals by about 2 degrees until strengths of from 40 to 60 degrees can be overcome without difficulty. This requires from three to six months. After this time, the exercises are stopped, and the patient is left to continue at his work, usually relieved of all difficulty.

DISCUSSION

DR. WILLIAM ZENTMAYER: The value of prism exercises in dealing with convergence insufficiency has long been recognized. A distinction should be made between convergence power and adducting power. Convergence power is defined as the point nearest to the eye at which single vision can be maintained, and adducting power as the strongest prism, base out, with which single vision can be maintained. It is quite common to have good convergence power with low adduction power, and vice versa. It is a question whether exercise with prisms increases the muscular power of the internal recti or whether it increases the innervation of these muscles. As a rule, when divergence excess is added to convergence insufficiency, exercise with prisms is not so efficacious as it is in cases of simple convergence insufficiency. Frequently, when patients put on presbyopic glasses for the first time, thus relieving their muscles of accommodation, there also results a lessening of convergence power. The best way to avoid the discomfort occasioned is to give the weakest reading glass with which the patient is able to do necessary near work. If this is not sufficient, it is then particularly that exercise with prisms is of value.

ARTERIAL GROOVING OF THE OPTIC CHIASM ASSOCIATED WITH PITUITARY TUMORS. DR. WALTER I. LILLIE.

Dr. Holloway's attention was first called to the subject about 1912 when Dr. de Schweinitz and he were working on scotomas induced by pituitary lesions. Foster Kennedy's article came out about that time, and Dr. Holloway felt that this syndrome might be dependent in certain instances on vascular constriction. The character would depend on the location of the tumor, whether anterior or posterior, above or below the chiasm. Among the early cases was one recorded by Oppenheim, in which hydrocephalus was the exciting cause. However, the contribution that chiefly attracted attention to this subject, especially in this country, was de Schweinitz' Bowman Lecture. In the earlier days, doubtless, many instances of this condition were overlooked at autopsy.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Dec. 17, 1934

WEBB W. WEEKS, M.D., *Chairman, Presiding*

GUERNSEY FREY, M.D., *Secretary*

THREE CASES OF KERATITIS NUMMULARIS DIMMER. DR. HERMAN ELWYN.

In 1905 Dimmer described a corneal lesion which he called keratitis nummularis. Cases of a similar lesion were reported by Salzmann before the congress in Heidelberg in 1928, and in 1933 Aust reviewed 27 cases which he had observed in Vienna. In 1934 Salzmann reviewed 64 cases observed in Graz, Austria. Recently, I have seen 3 cases of a lesion which seems to fit in with the clinical description given by Aust, and to permit classification as keratitis nummularis Dimmer.

Case 1.—P. L., a man 51 years old, had vision in the right eye equal to 20/20 and vision in the left equal to 20/20 without correction. With + 0.25 D. sph. ⊂ + 0.25 D. cyl., axis 90° for each eye vision in each eye was 20/20 + 3.00. Examination showed 14 distinct lesions in the right cornea and 17 in the left, ranging from 0.5 to 1.5 mm. in diameter, with clear cornea between them. The individual lesion was grayish, irregularly round, sharply demarcated and situated in the anterior third of the cornea. Many of the lesions showed central depression. The epithelium over the abnormalities was intact and did not stain with fluorescein. There was no vascularization of the cornea or ciliary or conjunctival injection.

Case 2.—M. L., a woman 36 years old, at a routine medical examination was noticed to have, on the cornea, some spots which were not seen two years previously, and her physician advised her to see an ophthalmologist. Without correction vision in the right eye was 20/30 and vision in the left was 20/40. With + 0.50 D. cyl., axis 165°, vision in the right eye was 20/20, and with — 0.75 D. cyl., axis 80°

vision in the left eye was 20/30. In the cornea of each eye were lesions, the exact counterparts of those in case 1. Some of the lesions showed slightly more central depression (saucer-shaped). The epithelium over the individual lesions was intact and did not stain with fluorescein. There was no vascularization of the cornea, ciliary injection or dilatation of the conjunctival vessels.

Case 3.—G. P., 29 years old, was seen in the New York Eye and Ear Infirmary in 1932, with an ocular disease that was first diagnosed as keratitis superficialis punctata. The patient has disappeared, but stereoscopic pictures of each eye show the corneal lesions to be of the same character as in cases 1 and 2. There was no ciliary or conjunctival injection. Aside from the corneal lesions, both eyes were normal. Vision in the right eye without correction was 20/50; that in the left, 20/50. With + 2.50 D. sph., ⊃ + 0.50 D. cyl., axis 90° for each eye, vision in each eye was 20/40.

Comment.—The observations in these three cases correspond so closely to the descriptions of keratitis nummularis Dimmer as given by Aust and Salzmann that the cases must be classified as instances of that disease. Aust divided the clinical course of the disease into three stages. In the first stage, the individual lesion has a grayish, stippled appearance and is slightly raised above the surface of the cornea. In the second stage, the lesion is flatter and has a central dense area with a more diffuse grayish halo around it. In the third stage, the halo has disappeared, and the lesion is sharply demarcated, depressed in the center and faceted. The changes in the three cases reported here evidently belong to the third or the healed stage. The only difference between these cases and those reported in the literature is the bilateral involvement in these. As the lesions, when they came under my observation, were in the healed stage, it is impossible to say whether both eyes became involved at the same time or successively.

The etiology is unknown. As to the place of this disease in the scheme of corneal diseases, both Aust and Salzmann are inclined to place it among those caused by an infectious agent. Salzmann places it in a position midway between keratitis superficialis punctata and keratitis disciformis, to both of which it seems to be related.

DISCUSSION

DR. PERCY FRIDENBERG: Will Dr. Elwyn tell us about the intra-ocular pressure and about the corneal sensitivity in his patients?

DR. HERMAN ELWYN: The intra-ocular pressure was normal, and the corneal sensitivity was slightly and equally diminished in both eyes.

SOME FACTORS IN THE PRACTICAL APPLICATION OF THEORETICALLY CORRECT OPHTHALMIC LENSES. DR. ALFRED COWAN, Philadelphia.

Hypothetically, in order for an ametropic eye to be made emmetropic by the addition of a correcting lens, three conditions must be satisfied: 1. The posterior principal focus of the lens must coincide with the far point of the eye. 2. The posterior principal point of the lens must coincide with the anterior principal focus of the eye. 3. The pole of the correcting lens must coincide with the visual line of the eye.

Condition 1.—To satisfy this condition, the correcting lens may be placed anywhere in front of the eye as long as it lies at its focal distance from the far point of the eye. In hyperopia, since the far point lies behind the eye, the lens may be placed anywhere in front of the eye; the greater the distance, the weaker the lens will necessarily be. In myopia, the lens may be placed anywhere between the eye and its anterior principal focus; the closer to the eye, the weaker the lens must be.

In the higher grades of ametropia the distance from the eye to the glass is of importance, but in the lower grades a small variation is negligible.

Condition 2.—After complying with this, the correcting glass will have no effect on the size of the retinal image.

In myopia, the size of the image is increased the closer the lens is placed to the eye. The reverse is true in hyperopia.

Condition 3.—It is incorrect to state that the optical center of the lens should be placed before the center of the pupil. It should be remembered that the visual line does not cut the exact center of the pupil in the normal eye. In certain abnormal conditions, it may not go through the pupil. Also the optical center is not a line. It is a point which lies on the optic axis of the lens—inside on one of its surfaces or outside the lens. The plane of the correcting lens must be perpendicular to the visual line of the eye.

When the three conditions are satisfied, an ametropic eye will be made emmetropic, but only so long as the eye and the lens before it are fixed. The entire arrangement is disturbed and various types of errors are introduced whenever the eye turns from the primary direction.

Theoretical accuracy should always be the aim of the ophthalmologist in the correction of ametropia. But one must realize that an ideal combination of the living eye and its correcting glass is impossible, and that the adaptability of the normal eye makes such perfection unnecessary. One's knowledge of the basic optical principles should be utilized not only to secure the best results but also to sense that point beyond which exacting laboratory methods would be superfluous.

DISCUSSION

Dr. Le Grand H. Hardy (discussing the effect on refraction of variation in the distance of the lens from the cornea and of failing to control the lens area through which the patient's vision is tested): The patient may introduce or compensate a considerable amount of astigmatism by tilting or rotating the head so as to look obliquely through the test lens.

From graphs indicating proximity to Tscherning's curves of theoretically correct ophthalmic lenses, it may be inferred that in the range from + 10 to — 10 diopters the Micoquille lenses are best, while in the range from — 10 to —17 diopters the periscopic lenses are best, and from — 17 to — 25 diopters the planoconcave lenses more nearly approach the ideal.

Traumatic Ophthalmoplegias as a Workmen's Compensation Problem. Dr. Mark Davidson.

Among 10,000 examinations at the Workmen's Compensation Bureau 71 traumatic ophthalmoplegias figured: 52 were due to basal fractures

with positive roentgen evidence or unconsciousness, 17 were due to periorbital and intra-orbital injuries, and 2 were psychogenic. The elevators were involved in 45 per cent of the first group. In 25 per cent there were paralytic mydriasis and enophthalmos, mainly with involvement of the elevators. The apical syndrome was very rare. The patients with orbital injuries often complained of dizziness, headache and blurring rather than of diplopia, and the elevators were involved in 60 per cent. The vulnerability of these muscles accords with their frequent involvement in trauma sustained at birth and first involvement in nontraumatic third nerve paralysis. A psychogenic divergence paralysis followed prolonged occlusion for a lime burn. A 10 diopter prism to each eye completely restored perception of depth. Another psychogenic condition was a hysterical unilateral ptosis.

Compensation is awarded for loss of binocular single vision, and the problem is to determine the amount lost. Objective methods which lend themselves to graphic registration are therefore preferred. The charting of diplopia is a subjective method handicapped by incidental organic or psychogenic monocular polyopias, by attention to diplopia and by varying results depending on whether the testing is from single vision to diplopia or inversely. The screen test is uncertain in the movements of minor adjustment, particularly in outlying oblique positions, where vertical are complicated by horizontal deviations; it does not permit graphic registration and is not simulation proof. The Hess method of graphic registration is objective and useful. However, since all fusion impulses are excluded, it does not demarcate the transition zone of heterophoria which lies between the fields of orthotropia and heterotropia. It needs improvements of a mechanical nature. Suppression interferes with all three methods.

The Perlia test has been modified and adapted by me for the exploration of the field of binocular single vision directly in terms of depth perception. The subject is given a 2 mm. white spherical test object (veil pins in holders) and is requested to hold it at arm's length (50 cm.) and bring it up from some distance in the transverse vertical plane to touch a similar test object held by the examiner. With the subject's head immobile and facing a tangent curtain and the test objects a few inches in front of the curtain, one can rapidly explore the normal field of binocular stereopsis. The results are recorded as plus (or successful) and minus (or failure) on a record. The Perlia test is a powerful stimulus to stereoscopic vision and an objective performance control test of diplopia. By shifting the position of the test objects for each performance, the examiner eliminates the subject's muscle sense. By helping the subject and maintaining the test object stationary, he detects simulation in cases of persistent negative results. Ataxia and tremors, when present, are too obvious to lead to error. A positive result in the Perlia test means touching the test object in the transverse vertical plane without fumbling and neither from the front nor from the back and repeating the performance indefinitely. An accidental contact cannot be repeated. A 2 mm. test object provides for a low visual acuity of 20/300 and for a low stereoscopic acuity of 100 seconds of arc. The latter is within the normal variations of binocular stereopsis. One mm. test objects may be used for finer work. Uniocular judgment of depth has a threshold at least ten times higher. Objects are missed

anteroposteriorly by 2 cm. and more. Persons with vision in but one eye, those with monocular aphakia, other high anisometropes, persons with ophthalmoplegias in their fields of diplopia and squinters all give negative results in the Perlia test. Patients with pure horizontal heterotropias of low degree give occasional positive results in either the upper or the lower field, since convergence decreases in elevation and divergence in depression. The Perlia test is applicable to deaf and dumb persons and to persons of low intelligence. It is therefore most useful in examining persons with ophthalmoplegias for the purposes of compensation.

DISCUSSION

DR. JAMES W. WHITE: Dr. Davidson's use of the diplopia, Hess and Perlia tests is interesting. His object, however, is apparently to detect the malingerer and any attempt on the part of the examined person at falsification. The usual diplopia test is so easily falsified that it cannot be depended on; I use it only as affording additional proof and not as diagnostic. The Hess test has somewhat the same limitations, and besides, it is so difficult to procure exactly complementary colors that simulation is quite possible. The Perlia test is excellent, and in the event that the subject tries to pass and fails to do so, he will have given conclusive proof of a defect in binocular single vision throughout the whole or some part of the field of vision. The malingerer, however, need use but little imagination to know that he should not make the pins meet when it means dollars in his pocket to fail—and so he past points. Any one of these tests is of more worth, therefore, when the subject has a desire to pass the examination, as in aviation examinations; if a subject wants to fail, it is very difficult, if not impossible, to prove that he is malingering.

The screen test is the only one by which an attempt at falsification can be detected. This test is used for distance, near and in the six cardinal fields by screening from one eye to the other as is usually done. This is followed by a modification of the screen test to determine whether the deviation is a phoria or a tropia. While the subject fixes an object for distance, near and in the six cardinal fields, first one eye and then the other is covered and uncovered while the observer notes any change in fixation. This purely objective test proves, without any possible way to falsify the result, whether the condition is a phoria or a tropia in any or all positions. The findings should be recorded on a card which gives the amount of deviation in each field as measured by prisms, with a statement as to whether the condition is a phoria or a tropia.

DACRYADENITIS IN HYPERTHYROIDISM. DR. ALGERNON B. REESE.

This paper was published in full in the May 1935 issue of the ARCHIVES, page 855.

MYOPIA. DR. DANIEL M. ROLETT.

This paper will be published in full in a later issue of the ARCHIVES.

Book Reviews

The Visual Field, Normal and Pathologic. By Dr. Jorge Malbrán, Oculist to the Rawson Hospital and Professor of the Ophthalmologic Clinic. Paper. Pp. 401, with 153 illustrations. Buenos Aires: El Ateneo, 1934.

The introduction gives a brief historical sketch of the development of the study of visual fields, from the first description of the concepts of "central and peripheral vision" by Galen, in the second century, to the modern advancement of perimetry by Ferree, Rand and others in the twentieth century. Because of the dearth of publications on the subject in his country, Malbrán has been motivated to offer in the present work the results of daily personal studies extending over a period of more than five years.

In the first part he takes up the anatomy and physiology of the optic tract, describing what he believes is the most nearly correct distribution of the optic radiation in the calcarine cortex according to the recent work of Balado. Then follows a description of the normal visual field, together with a detailed discussion of the intrinsic and extrinsic factors modifying it. A short chapter is devoted to the technical fundamentals of perimetric examination; the efforts of Peter, Traquair and Lauber toward standardization of methods and uniformity of results are cited, and a comparative study of the perimeter and the campimeter is made. The final chapters of this division are concerned with a complete portrayal of the many instruments used in perimetric studies and the methods of examination of the visual field.

The second part, which embraces about two thirds of the treatise, is devoted to the pathologic field. The first chapter considers in a general way the modification in form and extent and the various types of scotoma. Viewing the visual field as representing "an island of vision in a sea of blindness," Malbrán uses the terms "depression" and "erosion of the coast" when there is a narrowing or contraction.

Under choroidal diseases the fields are shown in choroiditis and chorioretinitis (syphilitic, tuberculous and other forms), choroidal changes in myopia, photogenic and actinic chorioretinitis, gyrate atrophy (Fuchs) and choroideremia, coloboma and rupture of the choroid. Under retinal diseases are those in which the external layers are involved: pigmentary retinitis, retinitis albescens, macular pigmentary retinitis (Stargard), hereditary syphilitic retinitis, and diseases in which the involvement lies principally in the internal layers, such as obstruction of the retinal arteries, retinitis juxtapapillaris (Jensen) and myelinated nerve fibers. Thrombosis of the retinal veins, hypertensive retinitis and detachment of the retina are separately treated.

The chapter on glaucoma considers the incipient, confirmed and terminal stages of the disease. The characteristics of perimetric symptomatology are grouped according to the following classification: (1) the character of the scotomas or principal defects in the para-

central area of the field the configuration of which follows the distribution of the nerve fibers of the retina; (2) the tendency of the defects to assume symmetrical forms in the superior and inferior halves; (3) the greater tendency toward loss of the nasal field, as compared with the temporal portion; (4) the prolonged conservation (in spite of the presence of considerable peripheral loss) of central vision, which is maintained until the terminal phase, and (5) the relative integrity of the fields for colors. The two principal factors (the hypertension and the vascular state) responsible for the symptoms are discussed and their rôle evaluated.

There is a short chapter on papilledema and papillitis.

Retrobulbar neuritis, the toxic amblyopias and optic atrophy are thoroughly covered. The handling of tobacco amblyopia is especially noteworthy.

The final divisions are concerned with the diseases of the chiasm and the retrochiasmatic portion of the optic tract. These are described in detail and illustrated with a profusion of charts of fields and diagrams. The processes resulting in the production of the various hemianopias (temporal, altitudinal, diagonal, binasal and others) are outlined; the effects of the various intracranial tumors are shown, and the cortical localization of the macula is discussed.

The volume covers the subject exhaustively. The contents are arranged in orderly sequence and presented in an interesting manner. The book is replete with illustrations, and there are sixteen pages of bibliography.

S. L. RHODE.

Eye Health Study of Texas School Children. By J. Guy Jones, M.D.; F. L. Hemphill, M.Ed., and Jeanie M. Pinckney, M.A., Pp. 81. Austin, Texas: Bureau of Nutrition and Health Education, Extension Division, the University of Texas, 1934.

This study of 5,748 white school children (in grades 1 to 11) from four widely separated school systems in Texas was made to determine the incidence of various kinds of ocular defects at the various grade levels and to determine the light intensity under which the children were working while in school. Of the 5,748 pupils, 1,359 were referred for ophthalmologic examination; of these, 1,162 were examined.

Of the 1,162 pupils, 251 were found to be normal; 370 were advised to start wearing glasses; 251 were advised to continue wearing their present glasses; 81 were told to have their glasses changed; 127 had pathologic conditions requiring treatment; 11 were recommended for sight-saving classes, 3 were recommended for admission to an institution for the blind, and 126 were recommended for further ophthalmologic examination. (Some children received more than one recommendation.) Also, among the 1,162 children there were 277 who had some pathologic condition other than or in addition to refractive errors.

In the study of the lighting of classrooms a detailed analysis of the light intensity was measured in 203 classrooms on (1) clear days, (2) cloudy days and (3) cloudy days in which all available light (artificial and natural) was being utilized. The National Society for the Prevention of Blindness recommends 8 foot-candles as the mini-

mum light intensity needed for classroom work, while the School Plant Division of the Texas State Department of Education recommends 6 foot-candles as the absolute minimum. The light intensity was measured by a 603 Weston illumination meter, but a sight-meter is recommended as most practical for teachers' use.

On clear days 1,101 working points were measured. Approximately one half of the reading and writing points were subminimal (less than 8 foot-candles). Also, about one third of these 1,101 points measured less than 6 foot-candles. On cloudy days 765 working points were measured. About two thirds of these were subminimal. On cloudy days, using the maximum available light, 765 working points were investigated. About two fifths of the working points were below 8 foot-candles.

The majority of front blackboards showed readings of subminimal light intensity at all times.

Factors influencing the intensity, quality and distribution of light included: the relationship of the area of the floor to the area of the windows, the direction of the light (from the left is considered best), the exposure (the south is the least advantageous, and the east is usually the most advantageous), the type of window-shades and their placement and the width of the mullions. In the 203 classrooms 368 glaring objects were recorded, of which 358 were pictures. No ceilings had the recommended reflective value of 80 per cent, but 19 closely approached this standard. One hundred and fifty-nine of the rooms had a reflective value of 50 per cent for the upper walls, only 44 being below the standard in this respect. The artificial light was extremely variable in all the rooms studied.

Thirty-three per cent of the 5,748 children examined were sitting in areas of subminimal light intensity. Nine hundred and eleven (15.8 per cent) were found to have normal ocular conditions. No attempt was made to prove a causal relationship.

The pamphlet closes with a number of recommendations and an outline for instruction in ocular health which seems to be sound and conservative.

W. F. DUGGAN.

Ophthalmology. By S. A. Agatson, M.D. Price, $2. Pp. 170. Distributed by John L. Scoenfeld Co., New York, 1935.

This work is a compendium of the salient features of diseases of the eye for the use of the undergraduate medical student. Dr. Bernard Samuels has written a foreword, and there is a preface by Dr. Webb W. Weeks. As the book is offered only as an epitome of ocular diseases, no fault can be found because of the omission of many diseases or the necessarily scanty treatment of others.

The brief anatomic introductions to each section are excellent because of their brevity. In the section on strabismus no mention is made of advancement as one of the accepted operative procedures.

Owing to the briefness of the text and the lack of illustrations and diagrams, the book cannot be used in place of the usual texts by May, Parsons and others. However, as it is offered only as an outline of Dr. Agatson's courses at Bellevue Hospital, it undoubtedly fulfils the intentions for which it was written.

W. F. DUGGAN.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General pro tem: Dr. A. Churchill, 66 Boulevard St. Michel, Paris.

International Ophthalmologic Congress

Secretary: Dr. Francisco Poyales, Olozaga 3, Madrid.
Place: Cairo. Time: 1937.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. A. J. Ballantyne, 11, Sandyford Pl., Glasgow, C 3.
Secretary: Dr. J. Ringland Anderson, 108 Collins St., Melbourne.
Place: Melbourne. Time: Sept. 11-13, 1935.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. R. Foster Moore, 53, Harley St., London, W. I.
Secretary: Miss Ida Mann, 7, Wimpole St., London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 4-6, 1935.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Ransom Pickard, 31, East Southernhay, Exeter, England.
Secretary: Dr. J. D. Magor Cardell, 27, Weymouth St., London, W. 1.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

Secretary: Prof. A. Wagenmann, Heidelberg.

Chinese Ophthalmological Society of Peiping

President: Dr. P. H. Liu, Chi-Ming Eye Clinic, Ta Liu Pu Kau, Peiping.
Secretary: Dr. H. H. Feng, Peiping Union Medical College, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

TSINAN OPHTHALMOLOGICAL SOCIETY

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Arthur J. Bedell, 344 State St., Albany, N. Y.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Atlantic City, N. J. Time: June 10-14, 1935.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
President-Elect: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Cincinnati. Time: Sept. 16-20, 1935.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. Walter B. Lancaster, Boston.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.

SECTIONAL

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. James J. Regan, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. Benjamin Sachs, 483 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. Frank B. Kistner, Mayer Bldg., Portland, Ore.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Francis A. Brugman, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Noble Dick, 1115 Terry Ave., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Harry Shearer, 405 E. Grand Ave., Beloit, Wis.
Secretary-Treasurer: Dr. W. S. Beyer, 1101 Talcott Bldg., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Charles H. Baker, 805 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: First Friday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. J. J. Hompes, 1307 N St., Lincoln, Nebr.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.
Place: St. Louis. Time: November 1935.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. F. B. Fralich, 203 S. Main St., Ann Arbor, Mich.
Secretary-Treasurer: Dr. A. S. Barr, 201 S. Main St., Ann Arbor, Mich.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Claude W. McKee, 229 S. Main St., Greensburg.
Secretary-Treasurer: Dr. C. W. Beals, 41 N. Brady St., DuBois.
Place: Indiana. Time: October 1935.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Arthur M. Yudkin, 257 Church St., New Haven.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. Herschel C. Crawford, 26 Lindon Ave., N. E., Atlanta.
Secretary-Treasurer: Dr. J. A. Smith, 700 Spring St., Macon.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Ora G. Brubaker, North Manchester.
Secretary: Dr. Frederick V. Overman, 705 Hume-Mansure Bldg., Indianapolis.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. F. W. Dean, 532, 1st Ave., Council Bluffs.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.
Place: Council Bluffs. Time: Nov. 7, 1935.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. John W. Orr, 503 S. Saginaw St., Flint.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. James A. Reynolds, 78 S. 9th St., Minneapolis.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. Lawrence G. Dunlap, 101 Main St., Anaconda.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. James A. Fisher, 501 Grand Ave., Asbury Park.
Secretary: Dr. William K. Campbell, 96 Third Ave., Long Branch.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION
Chairman: Dr. Webb W. Weeks, 20 E. 53rd St., New York.
Secretary: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY
President: Dr. W. R. Winn, 702 First Ave., S., Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 516 Fourth St., Valley City.
Place: Minot. Time: June, 1935.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY
President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY
Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. Josiah E. Smith, 60 Meeting St., Charleston.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. Eugene Orr, 706 Church St., Nashville.
Secretary-Treasurer: Dr. W. D. Stinson, 248 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY
President: Dr. T. E. Fuller, 100 W. Broad St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY
President: Dr. William Stookey, 54 E. South Temple St., Salt Lake City.
Secretary-Treasurer: Dr. T. F. Welsh, 711 Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY
President: Dr. Beverley R. Kennon, 142 W. York St., Norfolk.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION
President: Dr. W. F. Beckner, 1050 Fifth Ave., Huntington.
Secretary: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT
Chairman: Dr. Alfred Stahl, 55 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY
President: Dr. Herschel Crawford, 478 Peachtree St., N. E., Atlanta, Ga.
Secretary: Dr. Stacy C. Howell, 384 Peachtree St., N. E., Atlanta, Ga.
Place: Academy of Medicine, 13 Queen's Park. Time: 8 p. m., last Thursday of each month.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Lloyd B. Whitham, Mt. Vernon Pl. and Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

BUFFALO OPHTHALMOLOGIC CLUB

President: Dr. H. H. Glosser, 448 Franklin St., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

CHICAGO OPHTHALMOLOGICAL SOCIETY

President: Dr. E. V. L. Brown, 122 S. Michigan Ave., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

CLEVELAND ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. A. D. Ruedemann, 2020 E. 93d St., Cleveland.
Secretary: Dr. Fred W. Dixon, 1029 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

CLEVELAND OPHTHALMOLOGICAL CLUB

Chairman: Dr. A. B. Bruner, 629 Euclid Ave., Cleveland.
Secretary: Dr. M. W. Jacoby, Hanna Bldg., Cleveland.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

COLUMBUS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

Chairman: Dr. W. C. Davis, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. H. M. Sage, 9 Buttles Ave., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. W. Mood Knowles, 1719 Pacific Ave., Dallas, Texas.
Secretary: Dr. L. H. Quinn, 4015 Live Oak St., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. C. C. Walker, 410 6th Ave., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Secretary-Treasurer: Dr. W. C. Mott, 214 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. T. L. Goodman, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. John H. McRae, 26 Sheldon Ave., S. E., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 307 Metz Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. R. M. Hargrove, 1202 Esperson Bldg., Houston, Texas.
Secretary: Dr. J. C. Dickson, 1617 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. C. H. McCaskey, 404 Continental Bank Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. Raymond E. Teall, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. A. W. McAlester, 2003 Bryant Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Russell T. Uhls, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Kenneth C. Brandenburg, 707 Security Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. F. H. Brandt, 1136 W. Sixth St., Los Angeles.
Secretary-Treasurer: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. E. A. Leggett, 614 Breslin Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. J. E. Craddock, 604 Breslin Bldg., Louisville, Ky.
Place: Jewish Hospital. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. R. S. Pendexter, 900, 17th St., N. W., Washington.
Secretary: Dr. Lyman B. Tibbets, 1801 Eye St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, 130 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. J. J. Brook, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6 p. m., second Tuesday of each month.

MONTREAL OPHTHALMOLOGICAL SOCIETY

President: Dr. J. A. MacMillan, 1410 Stanley St., Montreal, Canada.
Secretary: Dr. A. L. Guertin, 410 Sherbrooke St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Wesley Wilkerson, Bennie Dillon Bldg., Nashville, Tenn.
Secretary-Treasurer: Dr. Hale Cullom, Bennie Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. Webb William Weeks, 20 E. 53d St., New York.
Secretary: Dr. Guernsey Frey, 121 E. 60th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. John H. Judd, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Robert H. Rasgorshek, 425 Aquila Court, Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

PHILADELPHIA COUNTY MEDICAL SOCIETY, EYE SECTION

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Edward B. Heckel, 500 Penn Ave., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

PITTSBURGH SLIT-LAMP SOCIETY

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

RICHMOND OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Samuel M. Cottrell, 116 E. Franklin St., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

ROCHESTER EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Frank Barber, 75 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Laurence Macey, 221 Alexander St., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

ST. LOUIS OPHTHALMIC SOCIETY

President: Dr. Meyer Wiener, 308 N. 6th St., St. Louis.
Secretary: Dr. W. M. James, Metropolitan Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

SAN ANTONIO OPHTHALMOLO-OTO-LARYNGOLOGICAL SOCIETY

President: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

SAN FRANCISCO COUNTY MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Secretary: Dr. Louis F. Morrison, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

SHREVEPORT EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. John T. Crebbin, 632 Travis St., Shreveport, La.
Secretary-Treasurer: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of every month except June, July and December.

SPOKANE ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Marc Anthony, 422 Riverside Ave., Spokane, Wash.
Secretary: Dr. Raymond A. Lower, 1455 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

SYRACUSE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. D. F. Gillette, 109 S. Warren St., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

TORONTO ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. Clarence E. Hill, 160 Bloor St., West, Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

WASHINGTON, D. C., OPHTHALMOLOGICAL SOCIETY

President: Dr. William Thornwall Davis, 927 Farragut Sq., Washington, D. C.
Secretary-Treasurer: Dr. James N. Greear Jr., 1740 M St., N. W., Washington, D. C.
Place: Episcopal Eye and Ear Hospital. Time: 8 p. m., first Thursday in November, January, March and May.

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